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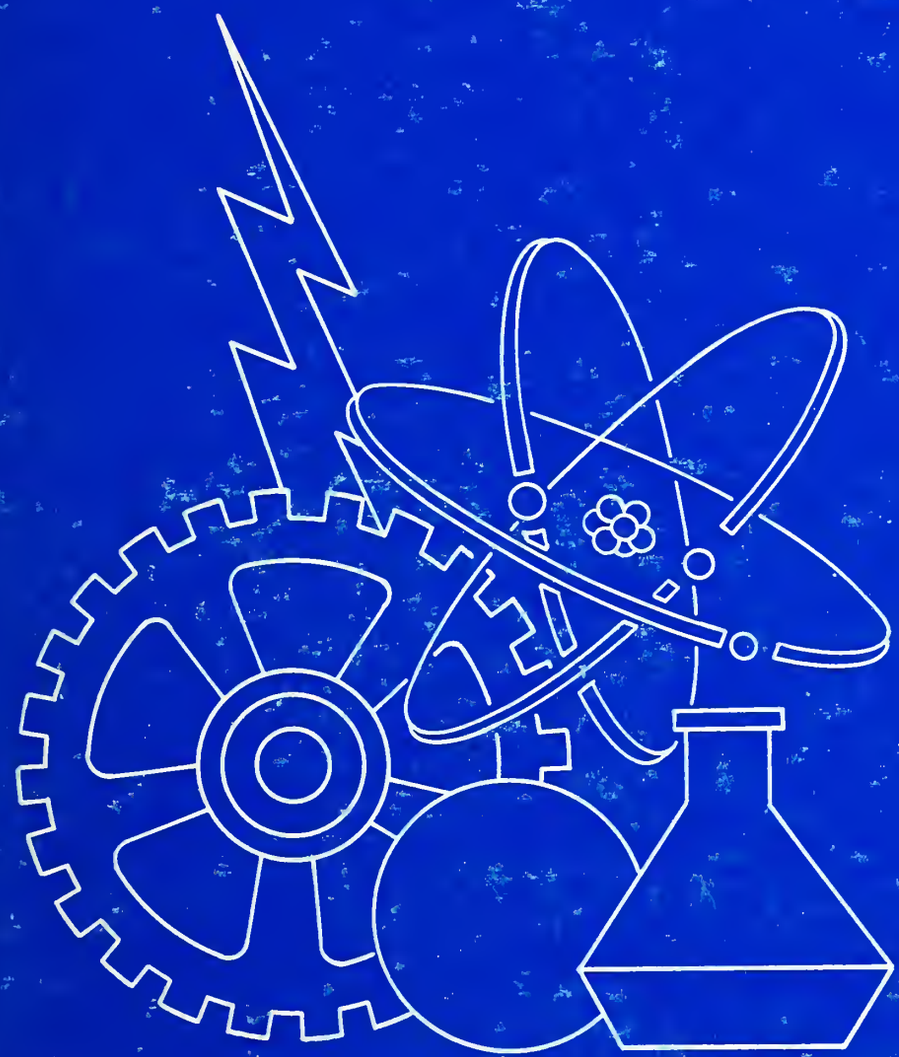
TECHNOLOGY ASSESSMENT & FORECAST

6TH REPORT



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TECHNOLOGY ASSESSMENT & FORECAST

SIXTH REPORT
June 1976

PENNSYLVANIA STATE UNIVERSITY
JUL 20 1976
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CONTENTS

INTRODUCTION 1

SECTION I -- ACTIVE TECHNOLOGICAL AREAS 5

High Foreign Share (Table) 10
High Overall Growth (Table) 11

Statistical Reports on Specific Areas 13

Vehicles:
Vehicle passenger restraints 14
Multiple piston actuated disc brakes 16

Information Handling:
Matrix display control systems 18
Multiplexed loop telecommunication systems 20
Programmed testers for data processing systems 22

Electrical & Electronic:
Regulated radiant energy systems 24
Electromechanical oscillators 26
Electrocardiograph electrodes 28
Underwater holography 30

Photography:
Still cameras with electric film advance 32
Photoelectrically controlled cameras 34
Multiple component lenses 36
Photothermic compositions 38

Chemical Compositions and Processes:
Azole derivatives 40
Pyrazolines and pyrazolidines 42
Polypyridyls 44
Plant growth retarders 46
Olefin disproportionation 48
Propagation of discrete cells 50
Fermentations 52
Blast furnace fuel 54

Machines:
Automatically controlled hydraulic type power plants 56
Electromagnetic fluid pumps 58
Rotary screen printing machines 60
Textile machine bobbin doffing apparatus 62
Transport systems for cassette recorders 64

Miscellaneous:
Antipollution devices 66
Bone and joint prosthesis 68
Metal casting utilizing electrodes 70
Irrigation type fluid decelerators 72

Examiner Reports On Specific Areas

Charge transfer devices 74
Surface acoustic wave devices 79
Algicides 91
Aminoglycoside antibiotics 102
Catalytic treatment of automotive exhaust gases 109
Fuel injected rotary piston engines 115
Four channel sound systems 121

SECTION II -- ENERGY TECHNOLOGIES 130

Introduction 130

Solar
Heaters, and space heating and cooling systems 132
Distillation and evaporation concentration 134
Direct conversion to electrical energy 136
Direct conversion to mechanical energy 138
Solar collectors and concentrators 140
Geothermal and other natural terrestrial heat energy 142
Tide and wave energy 144
Hot water or steam production from waste materials 146
Production of fuel from waste material 148
Electricity generated by wind (Examiner Report) 150

SECTION III -- COMPARISON OF ECONOMIC AND PATENT DATA 155

Background 155

Graphs

Figure 1 - U.S. organizational (Corp. & Govt.) patent activity in six selected industries combined 160
160

Figure 2 - U.S. organizational (Corp. & Govt.) patents by industry & year of application 161

Figure 3 - U.S. organizational (Corp. & Govt.) patents per million dollars R & D funding in six selected industries combined (patents by application date vs. funding two years prior) 162

Figure 4 - Professional R & D manpower per U.S. organizational (Corp. & Govt.) patent in six selected industries combined (patents by application date vs. manpower two years prior) 163

Figure 5 - U.S. organizational (Corp. & Govt.) patents per million dollars R & D funding (patents by application date vs. funding two years prior) 163

Figure 6 - Professional R & D manpower per U.S. organization (Corp. & Govt.) patent (patents by application date vs. manpower two years prior) 164

Figure 7 - Comparison in six selected industries of U.S. Corporate and U.S. government patenting per million dollars R & D funding (patents by application date vs. funding two years prior) 164

Figure 8 - Comparison across six selected industries of U.S. organizational (Corp. & Govt.) patents (by application date) per million dollars R & D funding (two years prior) vs. U.S. govt. share of the R & D funding. 165

SECTION IV -- MOST CITED PATENTS 167

Background 167

Patents Reviewed
Electronic ignition spark advance system 168
Method for refining pig-iron into steel 169
Fire-retardant sheath and core type conjugated fibers 169
Multiplexing system for selection of notes and voices in an electronic musical instrument 170
Skid control system 171
New articular prosthesis for surgical use 172

APPENDIX A - OBTAINING PREVIOUS OTAF PUBLICATIONS 173

APPENDIX B - OBTAINING ADDITIONAL INFORMATION ON SPECIAL REPORTS 174

APPENDIX C - SECTION III DATA TABLES 176

APPENDIX D - ACKNOWLEDGEMENTS 182

INTRODUCTION

Background

The Patent and Trademark Office has assembled one of the largest collections of technological literature in the world--the classified patent search file which contains twenty one million technological documents distributed among nearly 90,000 subdivisions of technology.

Each year about 250,000 new U.S. patent documents are added to this file, along with 280,000 new foreign patents. A sizeable staff is engaged full time in reviewing this file and restructuring it to accommodate new technologies and changes in existing technologies.

In its own unique way, this file represents a national resource; and, the Patent and Trademark Office recognizes its heavy responsibilities not only to preserve, maintain, and improve the file but, as well, to maximize its use for the greatest public benefit.

It was as part of its effort to discharge this latter responsibility that the Patent and Trademark Office established, in 1971, its technology assessment and forecast program.

In its most general terms, the mission of the program is to stimulate and enhance the use and usability of the patent file, and to assemble, analyze and make available meaningful data about the file. In carrying out this mission, the Office of Technology Assessment and Forecast (OTAF), which administers the program, has assembled and built a master data base covering all U.S. patents. It periodically updates this base and strives continually to add new data items to it. Recent additions to the base are patent application date data, and relationships between the Patent Classification system and the Standard Industrial Classification (SIC) system. This latter addition permits, for the first time, broad scale use of patent data in economic studies.

OTAF uses the data base in two principal ways: First, it periodically issues general distribution publications. These publications have included reports on highly active technological areas; areas experiencing high levels of patenting by foreign residents; profiles of the patenting patterns of the residents of selected foreign countries and U.S. states; and reviews of the patent activity of the most active patent assignees. In addition, several of the publications have examined the patenting in high interest energy technologies.

A listing of previous OTAF publications and information as to how they may be obtained can be found in Appendix A.

The second principal use of the OTAF data base is made in the preparation of special reports, tailored to individual needs. These reports, which are provided on a cost reimbursable basis, have been utilized by other government agencies and a number of private sector corporations. More information concerning this special report service can be found in Appendix B.

Patents And Patent Activity

Almost four million United States patents have issued since the first was granted on July 31, 1790. To facilitate the use of this large body of technology, these documents have been "classified" (categorized) into more than 300 broad technological groupings (called Classes) and nearly 90,000 specific technological categories (called subclasses). Together, these Classes and subclasses form the structure of the classified patent file.

Copies of a patent are placed in more than one subclass of this file when the patent contains significant technology pertinent to more than one subclass. With such multiple placement or "cross referencing" the patent file has grown to contain approximately 11,000,000 U.S. patent documents spanning the entire technological spectrum[a].

Since a patent obtained in the United States conveys no protection outside this country, and vice versa, it is common in this age of the "international market place", for inventors to obtain patents in more than one country. As a result, significant foreign inventions are almost always patented in the United States because it is such an important market. Thus, U.S. patent activity is representative not only of U.S. technological effort but, to a large extent, of foreign technological effort as well.

For example, the growth of foreign technological capabilities in the 1960's and 1970's has been mirrored by the growth, over the same period, of the share of U.S. patents granted to foreign resident inventors. In 1961, only about 17% of U.S. patents were issued to residents of foreign countries. However, by the end of 1975, the foreign share had increased to over 35%.

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[a] The file also contains 9 million patents of other nations and 1 million pieces of non-patent, technological literature. These documents have not as yet been included in the OTAF data base, and, consequently, are not reflected in the statistics presented in this publication.

This apparent interrelationship between technological and patent activity gave rise to the basic premise of the technology assessment and forecast program - that patent activity is an indicator of technological activity, both domestic and foreign.

About The Contents Of This Publication

This report is divided into four sections. In the first section, patent activity in selected portions (technological areas) of the patent file is reviewed. These file portions - individual subclasses or combinations of subclasses - were selected for review because: 1) they have been unusually active overall; or, 2) they have been the subject of unusually heavy patenting by foreign resident inventors.

For the majority of these reviews a new expanded format is used which differs from that employed in previous OTAF publications. Presented, in addition to the usual statistical data and definition, are brief descriptions of recent patents in the area. Also new is the presentation of patent activity distributed according to the dates patents were applied for, rather than the dates upon which the patents were granted. This represents a recently developed OTAF capability which should materially improve patent data usefulness, since a patent application date more nearly approximates the time the patented technology was developed than does the date of patent grant.

The first section concludes with "examiner reports" of seven active technological areas. These more in depth reviews, prepared by knowledgeable patent examiners, contain an analysis of the thrust of the technological activity in the area.

The publication's second section is devoted to examining the patent activity in selected energy areas. Included is an update of the activity in technologies relating to such natural energy sources as solar, geothermal, and tide and wave energy. These were first reviewed in OTAF's second publication (Early Warning Report, December 1973) which covered patenting through 1972. This report adds three more years of data (through 1975), presents the data by patent application date as well as patent grant date, includes brief descriptions of recent patents in the areas and, for solar energy, expands the categories to include solar collectors and concentrators.

The section also includes reviews of two energy technologies not previously included in OTAF reports. These are: the use of waste material for energy generation; and, the generation of electricity by use of wind power. The wind energy review is in the form of an "examiner report" (previously described) which concludes the section.

In the third section OTAF, for the first time in one of its publications, makes use of the U.S. Patent Classification system - Standard Industrial Classification (SIC) system concordance [b] to develop patenting data in SIC categories for use in patent activity vs. economic activity comparisons.

Six SIC categories have been chosen. Comparisons, over time, are made between patenting in each area and two of each area's economic indicators; research and development (R & D) expenditures, and R & D scientists and engineers employed.

The patent data in this section have been distributed on a patent application date basis. To our knowledge, this is the first time in any publication that patent application date data have be used on such a comprehensive basis.

The fourth section of the publication contains brief reviews of the five U.S. patents and one foreign patent which were most often cited as pertinent in patents granted during 1975. This information was obtainable because, since January 1975, all utility patents issued by the Patent and Trademark Office have been printed using computer techniques. A "spin-off" of this procedure is a magnetic tape ("data base tape") containing all information in each patent, including the extensive bibliographic information contained on the first page of each patent.

OTAF has been using some of this bibliographic data in its periodic file update process. Experimentation with the remaining bibliographic data is ongoing with a view to determining its value as a tool for patent file use analysis and for technology assessment purposes. The "most cited patents" review is but a sample of an output of this experimenation process.

The publication concludes with four appendixes. Appendixes A and B contain, respectively, information concerning OTAF's previous publications and its special report services. Appendix C contains the detailed tables of data used in Section III, Comparisons of Economic and Patent Data. Appendix D names and acknowledges the assistance of the many Patent and Trademark Office professionals who contributed to the publication.

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[b] This concordance was developed by OTAF with the support of the Science Indicators Unit, National Science Foundation. It relates the various Classes and subclasses of the Patent Classification System to fifty two Product Field categories corresponding to the Standard Industrial Classification System. Extensive raw data developed through use of this concordance was presented in OTAF's Fifth Report, August 1975.

SECTION I

ACTIVE TECHNOLOGICAL AREAS

Contents

In this Section patent activity is reviewed in selected portions of the patent file, each file portion representing a defined technological area. The reviews are divided into two groups:

High Foreign Share - areas in which a higher than normal proportion of the U.S. patents have been issuing to residents of foreign countries.

High Overall Growth - areas which have been the subject of extensive patenting in the U.S.

Following this introduction, a table is provided for each of these groups. Each table lists, in descending order of average percent growth or average percent foreign share, the technologies reported upon and indicates the page at which each report may be found.

Procedures And Criteria Of Area Selection

As in OTAF's Fifth Report (August 1975), active areas reported upon in this Section were selected on the basis of a comparison of activity among all subclasses in the U.S. Patent Classification system. Rankings of selected areas by high foreign activity and high overall growth were developed. To be considered for these rankings a subclass had to meet the following statistical criteria:

- for both the "growth" and "foreign share" rankings, a subclass had to contain no less than 100 total patents (insuring a reasonable size "bite" of technology).

- for the "foreign share" ranking, a subclass also had to have an average growth rate which, for the most recent three year period, was equal to or greater than twice the average for all technology (2.3%); i.e., its growth had to be at an average rate of at least 4.6% (insuring a reasonable level of activity in the technology).

The resulting rankings were then divided into the three categories (Electrical, Mechanical and Chemical), and in each ranking category top ranked areas (not covered in previous publications) were selected for review. These areas encompass a single subclass or a small grouping of subclasses.

There were two exceptions to this procedure -- the reports on Surface Acoustic Wave Devices and Charge Transfer Devices. These reports were prepared in late 1975 for purposes unrelated to this publication. Because, in each report, the technology covered appeared to be of significance, the growth rate high, and the potential interest widespread, the reports have been updated and included.

Thirty seven areas, 15 listed on the High Foreign Share table and 22 listed on the High Overall Growth table, are reviewed in one or the other of two different report formats. For thirty of these reviews, a new abreviated "mini-report" format is used to define and briefly to survey the activity in the area. The remaining seven reviews, all listed on the High Overall Growth table, are "examiner reports". These more in depth reports, prepared by patent examiners knowledgeable in the field, review the thrust of the technological activity represented by the patenting in the area.

Readers of examiner reports in previous OTAF publications have urged greater use of this format. However, these reports require the availability of a patent examiner having both knowledge in the technology, and the interest and time to prepare a report. Because such report writing is peripheral to an examiner's primary function -- patent examination -- and due to the normally heavy workload that function conveys, examiner reports in OTAF publications must necessarily be few.

The Mini-Reports

The new two page "mini-report" format includes both statistical data and a substantive review of activity in the form of brief descriptions of patents recently issued in the area.

Description Of Area And Recent Activity

The first page of each mini-report contains a title and a short definition of the technology encompassed. At the end of the definition are listed the U.S. Patent Classification system Class and subclass(es) upon which the report is based.

Next follows an "Activity Indices" table. Covering calendar years 1973-75, the table presents for the area, information as to the:

- Average Percent Growth, number of patents issued in a year, for each of 1973, 1974 and 1975, divided by the total number of patents from all preceding years, summed and divided by 3

- Average Percent Foreign , the number of patents issued to residents of foreign countries in the years 1973-75, divided by total number of patents issued in these years

- Average Percent Corporate Owned, the number of 1973-75 patents assigned at time of issue to U.S. or foreign non-government organizations -- mainly corporations -- divided by the total number of patents issued in this three year period

- Average Percent Government Owned, the number of 1973-75 patents assigned at time of issue to the U.S. or a foreign government divided by the total number of patents issued in this three year period.

Following the indices table is a brief, substantive review of the patent activity in the area including short descriptions of the area's recently issued patents. These descriptions are intended merely to convey the "flavor" of recent efforts in the area and should not be taken either as full reviews of the patented subject matter or as an official Patent and Trademark Office endorsement or evaluation of the patents described.

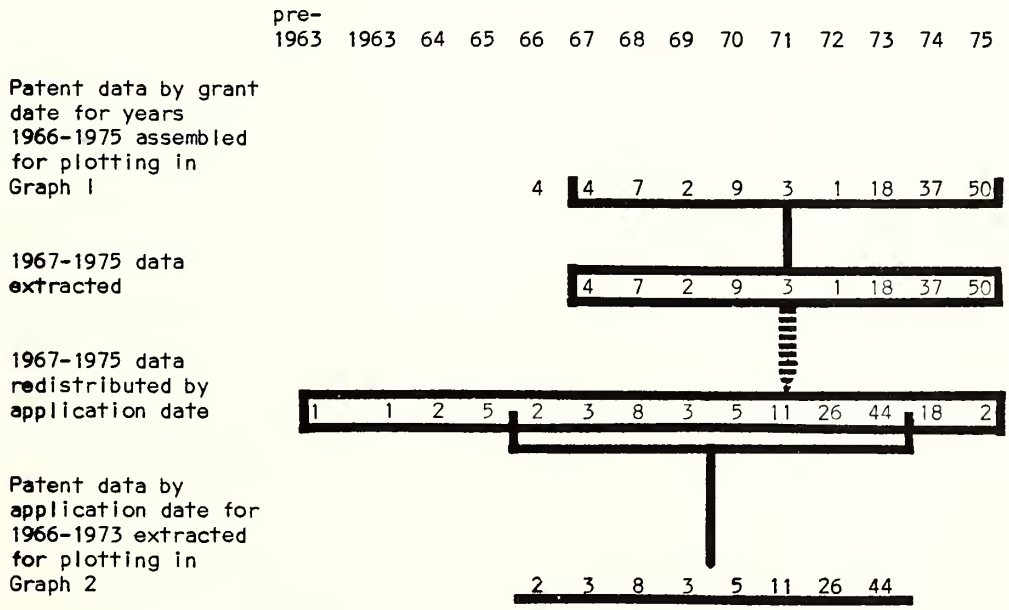
Explanation Of Data - Graphs And Table

The second page of each mini-report is a statistical review of the area's patent activity. Two graphic representations of that activity are presented. In the first, patents granted from 1966 through 1975 are distributed on the basis of the dates upon which they were granted. This distribution corresponds to the manner in which data have been presented in all previous OTAF publications.

In the second graph, for the first time in this publication series, patent activity is shown by application date. Patents which were granted from 1967 through 1975, are distributed on the basis of the dates upon which the applications for those patents were filed, rather than the dates upon which the patents were granted. That portion of the redistributed data which covers patented applications filed from 1966-1973 is shown on the graph.

The sequence of steps leading to conversion of 1967-1975 patent grant data into patented application data is illustrated in the table below. Shown is the process by which the 1966-1973 patented application data used in this Section was obtained. (The specific figures in the table are those for "Matrix Display Control Systems, page 18"). This same process was used to obtain the 1965-1973 patented application data employed in Section III.

CONVERSION OF PATENT GRANT DATA TO PATENTED APPLICATION FILING DATA


pre-1963 1963 64 65 66 67 68 69 70 71 72 73 74 75
Patent data by grant date for years 1966-1975 assembled for plotting in Graph 1
4 4 7 2 9 3 1 18 37 50
1967-1975 data extracted
4 7 2 9 3 1 18 37 50
1967-1975 data redistributed by application date
1 1 2 5 2 3 8 3 5 11 26 44 18 2
Patent data by application date for 1966-1973 extracted for plotting in Graph 2
2 3 8 3 5 11 26 44

Distributing 1967-1975 patents on an application date basis provides essentially complete data on those applications, which ultimately became patents, filed each year from 1965 through 1973. This is the case because there is a delay between the filing of a patent application and its subsequent issuance as a patent. The length of this delay (i.e., the "pendency" of an application) is determined by many factors, including Patent and Trademark Office workload (which varies between technologies), budget and man-power levels, patent printing schedules, etc.

In 1967, when maintenance of application date data in machine readable form began (and thus became subsequently available for inclusion in the OTAF data base) the average patent pendency was substantially in excess of two years. Consequently, patent applications filed in 1965 and 1966 were not issuing as patents until 1967 or later.

By the end of 1975, as a result of an ambitious and successful Patent and Trademark Office program, the average pendency had been reduced to about 20 months. This current average pendency renders data for years subsequent to 1973 incomplete. The obvious reason for this is that a significant number of the applications filed in 1974 and most of those filed in 1975 are still pending, have not, as yet, appeared as patents and, therefore, are not reflected in the OTAF data base. For this reason, the latest application date data given in this publication are for 1973.

The earliest patented application data given in this Section (for 1966) was selected to correspond to the beginning of the ten year span of patent grant data used (although 1965 patented application data is considered reliable and is used in Section III of the publication).

Readers should note that only applications which ultimately matured into patents are reflected in the application date data. Those applications which were filed but never issued (roughly 30% of total filings) are not included.

OTAF feels that even with its apparent limitations as to currentness [a], the application date data is of significant value, for the date an application is filed is a more accurate reflection of when the technology was developed. Additionally, fluctuation in data based on application date is much more likely to reflect changes in technological activity, since such fluctuation would, for the most part, be immune from, rather than the result of changes in Patent and Trademark Office application processing.

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[a] Generally, the application date data is less current than the patent grant date data by only a small amount; since they are but the same data differently distributed. In the application date distributions presented in this Section, the only loss in "currentness", as compared to the patent grant date distributions, are the few applications filed in 1974 and 1975 that issued in 1974 or 1975.

Following the graphs a "country table" is presented. This shows in numerical form the U.S. patent activity visually illustrated in the graphs. In addition, the table indicates, by country, the distribution of the foreign patenting (i.e., U.S. patents granted to residents of foreign countries). Because of space limitations, a maximum of ten named foreign countries are included in any table. Where there were more than ten involved, an "All Other" listing is used showing the combined patenting of these unnamed countries, the number of which is given in parenthesis following "All Other".

The Examiner Reports

Each of the seven examiner reports which conclude this Section go to greater depth of detail than do the mini-reports, in discussing the trends of development and recent activity in the area covered. The body of each report also includes growth and foreign share indices along with the same statistical data contained on the second page of the "mini-reports". Each report ends with a bibliography of the patents mentioned in the report or considered of interest to the discussion in the report.

HIGH FOREIGN SHARE TECHNOLOGIES

TECHNOLOGY	AVERAGE* % FOREIGN	PAGE
Still cameras with electric film advance	86.2%	32
Electromagnetic fluid pumps	83.3%	58
Metal casting utilizing electrodes	81.4%	70
Photoelectrically controlled cameras	80.6%	34
Polypyridyls	79.6%	44
Multiple piston actuated disc brakes	78.3%	16
Rotary screen printing machines	77.3%	60
Azole derivatives	77.3%	40
Blast furnace fuel	76.9%	54
Multiple component lenses	75.6%	36
Electromechanical oscillators	74.2%	26
Pyrazolines and pyrazolidines	72.7%	42
Textile machine bobbin doffing apparatus	71.7%	62
Regulated radiant energy systems	67.6%	24
Fermentations	66.0%	52

* For Calendar Year 1973-1975

HIGH OVERALL GROWTH TECHNOLOGIES

TECHNOLOGY	AVERAGE* % GROWTH	PAGE
Four channel sound systems**	112.2%	121
Matrix display control system	53.8%	18
Bone and joint prosthesis	46.8%	68
Surface acoustic wave devices**	43.4%	79
Programmed testers for data processing systems	30.4%	22
Transport systems for cassette recorders	30.2%	64
Multiplexed loop telecommunication systems	28.1%	20
Photothermic compositions	28.0%	38
Plant growth retarders	25.4%	46
Electrocardiograph electrodes	24.3%	28
Catalytic treatment of automotive exhaust gases**	22.4%	109
Propagation of discrete cells	22.2%	50
Antipollution devices	22.1%	66
Irrigation type fluid decelerators	21.7%	72
Automatically controlled hydraulic type power plants	21.0%	56
Underwater holography	19.5%	30

HIGH OVERALL GROWTH TECHNOLOGIES (cont.)

TECHNOLOGY	AVERAGE* % GROWTH	PAGE
Vehicle passenger restraints	19.0%	14
Charge transfer devices**	17.8%	74
Olefin disproportionation	17.4%	48
Algicides**	17.3%	91
Fuel injected rotary piston engines**	16.7%	115
Aminoglycoside antibiotics**	16.3%	102

* For Calender Years 1973-1975

** "Examiner Report"

STATISTICAL REPORTS
ON SPECIFIC AREAS

VEHICLE PASSENGER RESTRAINTS

Safety restraints, installed in vehicles, which utilize belts or other devices to keep the occupant of the vehicle from experiencing harmful movement during collision or excessive deceleration conditions. The restraint may be linked with other components which either automatically deploy it or disable the vehicle until it is deployed. These automatic systems are activated under various conditions, for example, when the vehicle door is opened or closed, the vehicle becomes occupied, or an actual collision or excessive deceleration condition occurs. (Class 180, subclass 82C; Class 280 subclass 150 SB)

Average Annual Activity Indices (1973-75)

Growth	19.0%	Corporate Owned	78.8%
Foreign Share	54.8%	Government Owned	0.9%

Recent Activity

Recent developments in this area are drawn to seat belt safety devices that emphasize comfort for the occupant of the vehicle; and, automatic restraining systems requiring minimum manipulation by the occupant. Patents which have issued since October 1974 include:

3,840,248 - (Fiala, Volkswagenwerk Aktiengesellschaft) - Discloses a system for impact responsive tension tightening of safety belt which restrains the knees of a vehicle occupant.

3,866,944 - (Takahashi, Mitsubishi Jidosha Kogyo Kabushiki Kaisha) - Discloses a seat belt retractor device in the vehicle door which binds the passenger when the door is closed and releases the passenger when the door is opened.

3,870,120 - (Blinkilde, Epsex International Inc.) - Discloses a device which locks the vehicle gear selector when the engine is started and maintains a locked condition until the restraining lap belts are coupled.

3,881,745 - (Chavez, Jr. E.) - Discloses a shoulder harness and lap belt device which prevents accidental disengagement of both harness and belt during an accident.

3,899,042 - (Bonar) - Discloses a device, actuated upon occupancy of the vehicle seat, consisting of a 2-part restraining arm. A first part pivots to a horizontal position parallel to the occupant. A second part pivots to a horizontal position in front of the occupant and slides backwards along the first part pinning the occupant snugly to the seat.

3,905,440 - (Okada et al, Hondu Giken Kogyo Kabushiki Kaisha) - Discloses a seat belt device having a freely turning retractor when only limited tension is applied thereto. Upon harsh shock or excessive deceleration, dual mechanical and electrical G-sensor switches lock the retractor.

3,907,059 - (Takada, Takata Kojyo Co., Ltd.) Discloses an automatic lap and shoulder belt buckling upon seat occupancy and closing of door.

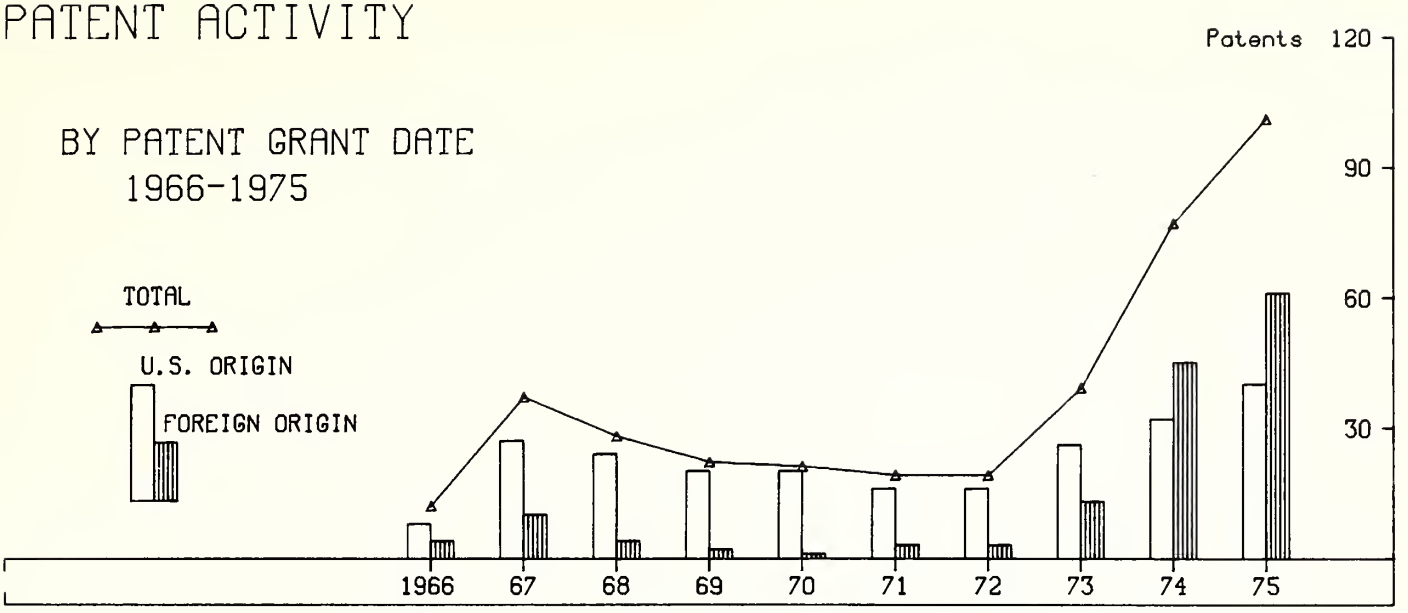
3,909,041 (Murakami et al, Nissan Motor Company Limited) Discloses a rear seat lap and shoulder belt assembly, with one end of the shoulder belt secured to a reinforced rear panel of the vehicle.

3,912,035 - (Ulert) - Discloses a lap belt tension relaxer device which provides a variable tension belt. The tension applied depends upon sensed pressure against the seat back.

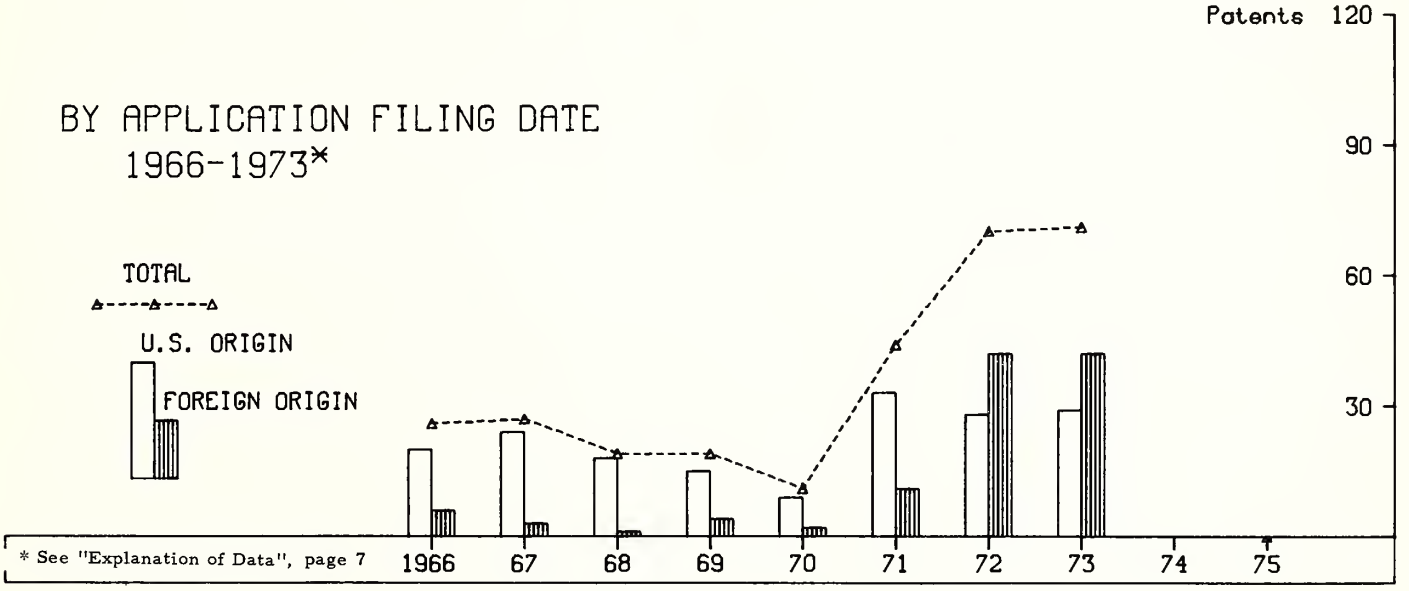
3,915,035 - (Lindblad) - Discloses a device having a reversible motor and an extending wire coupled to a safety belt which tightens the belt when the door is closed and loosens the belt when the door is opened.

PATENT ACTIVITY

BY PATENT GRANT DATE 1966-1975



BY APPLICATION FILING DATE 1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	12	37	28	22	21	19	19	39	77	101	375	26	27	19	19	11	44	70	71	287
UNITED STATES	8	27	24	20	20	16	16	26	32	40	229	20	24	18	15	9	33	28	29	176
TOTAL FOREIGN	4	10	4	2	1	3	3	13	45	61	146	6	3	1	4	2	11	42	42	111
JAPAN	1							3	13	26	43	1					2	14	17	34
GERMANY	1	2	1	1	1	1	2	4	13	16	42	3	1	1	1	1	2	12	14	35
UNITED KINGDOM	1	4						3	7	4	19	1					3	6	3	13
FRANCE	1	1					1	2	6	7	18				1	1	2	4	5	13
SWEDEN	1		1			1		1	2	8	14	1			1		2	3	2	9
CANADA		2	1						1		4							1		1
ITALY			1						1		2		1					1		2
YUGOSLAVIA						1					1				1					1
AUSTRALIA				1							1		1							1
ALL OTHER (2)									2		2							1	1	2

MULTIPLE PISTON ACTUATED DISC BRAKES

Disc brakes for retarding rotation about an axis of a wheel, pulley, disc or analogous element by forcing a plurality of piston actuated friction pads into contact with the sides of a disc. The pistons are mounted within fluid tight cylinders so that application of fluid pressure forces the pistons to move which in turn causes the appropriate brake pad movement parallel to the disc axis. (Class 188 subclass 72.5)

Average Annual Activity Indices (1973-75)

Growth	5.5%	Corporate Owned	82.6%
Foreign Share	78.3%	Government Owned	0.0%

Recent Activity

Recent developments have been directed toward increasing braking capacity while reducing size; promoting ease of brake pad replacement and economy of manufacture; and, reducing noise, vibration, and corrosion problems. Several recent patents disclose disc brakes of the "closed loop" type, i.e., one having 2 opposed pistons mounted in a single cylinder. One pad is directly driven against an adjacent disc face while the other is indirectly driven against the opposite disc face by means of a mechanical transfer arm. Patents, issued since October 1972, include:

3,698,518 (Boyles, Disco Industries Inc.) - Discloses a disc brake system with friction pads on both sides of the disc, contacting the full 360° of the disc. Each pad is driven by two piston-cylinders and is grooved for better heat dissipation.

3,724,606 (Kobayashi, Aisin Seiki Kabushiki Kaisha) - Discloses a "closed loop" disc brake which achieves a better load distribution in the force transfer arm by suspending the opposite brake pad from two widely spaced points formed by U-shaped guide pins in the plane of the arm.

3,729,069 (Klein et al, The Bendix Corporation) - Discloses friction pads wide enough to overlap both the inner and outer edges of the braking surface of the disc, reducing noise and disc corrosion.

3,730,306 (Rath, Girling Limited) - Discloses a disc braking system with a stationary cylinder housing bridging the periphery of the disc so as to leave openings for friction pad inspection. A pair of opposing pistons, mounted on either side of the disc, are subjected to equal pressure via internal porting in the bridging cylinder housing.

3,760,908 (Rath et al, Girling Limited) - Discloses a "closed loop" disc brake which reduces rattle and noise through use of a special plastic expansible bushing to connect the transfer arm to its actuator.

3,767,017 (Maurice) - Discloses a "closed loop" disc brake with the directly driven friction pad driven by two spaced pistons and a single piston of larger area driving the transfer arm in the opposite direction. This permits use of a larger directly driven pad.

3,884,384 (Toshida et al, Nissan Motor Co. Limited) - Discloses a closed loop disc brake in which the transfer arm is specially mounted to eliminate the necessity for it to carry the twisting moment generated by the braking torque. This promotes even friction pad wear and reduces vibrations.

3,869,024 (Hauth et al, Pont - A - Mousson S.A.) - Discloses a disc brake with opposing pads cam-driven toward the disc such that one pad tends to be self-locking and the other self-releasing. Means are provided automatically to restrict the advance of the self-locking pad while permiting further advance of the self releasable one to prevent brake lock up.

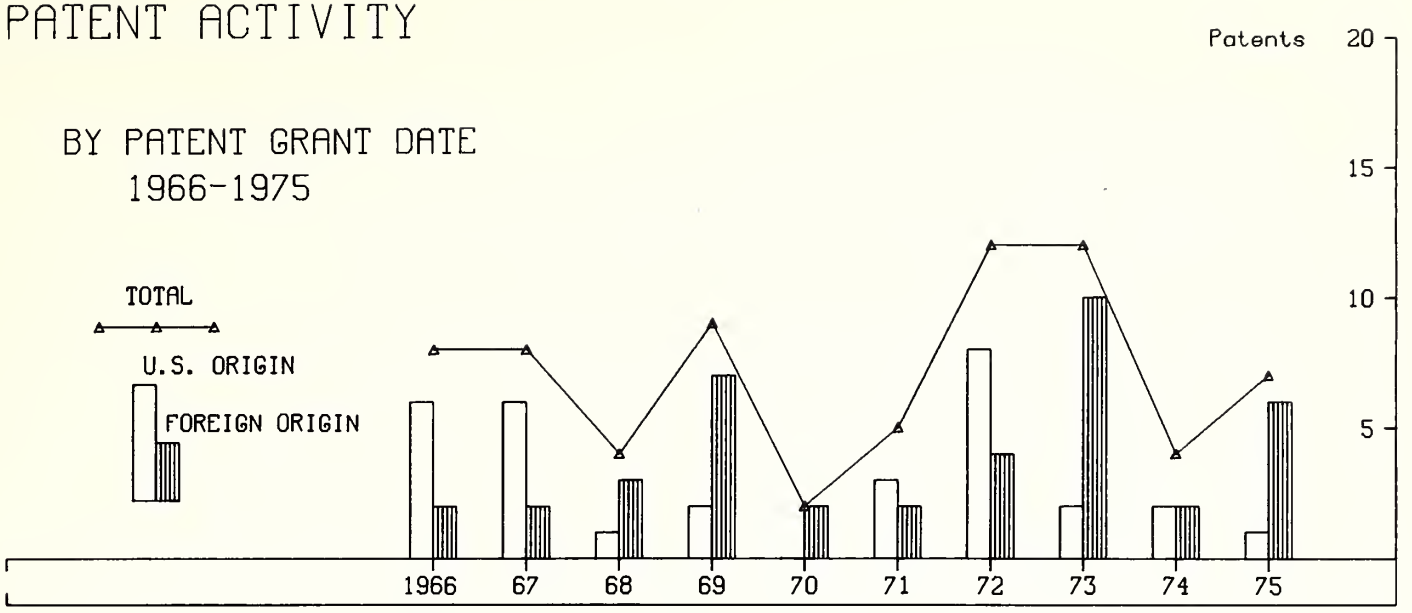
3,882,972 (Newstead et al, Girling Limited) - Discloses a disc brake which permits easy removal and replacement of the friction pads without disassembling the entire unit.

3,912,051 (Yokoi et al, Aisin Seiki Kabushiki Kaisha) - Discloses a "closed loop" disc brake having a cylinder of reduced overall length. Pistons are used which have one flat edge for space saving and one rounded edge for assembly purposes.

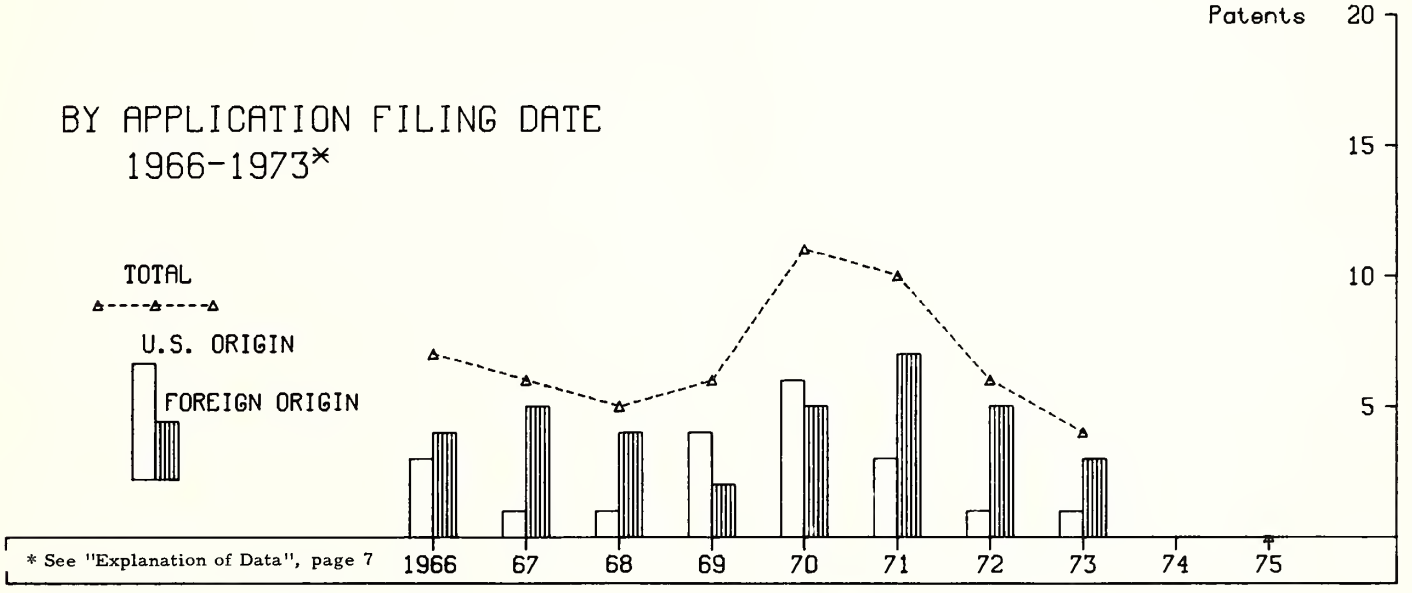
3,933,226 (Maurice) - Discloses a "closed loop" disc brake which uses a particularly rigid transfer arm support arrangement that is less expensive to manufacture.

PATENT ACTIVITY

BY PATENT GRANT DATE 1966-1975



BY APPLICATION FILING DATE 1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	8	8	4	9	2	5	12	12	4	7	71	7	6	5	6	11	10	6	4	55
UNITED STATES	6	6	1	2		3	8	2	2	1	31	3	1	1	4	6	3	1	1	20
TOTAL FOREIGN	2	2	3	7	2	2	4	10	2	6	40	4	5	4	2	5	7	5	3	35
JAPAN							3	5	2	4	14					4	4	3	2	13
UNITED KINGDOM	1		1	3			1	1		1	8	1	3		1		1	1		7
GERMANY	1	2	2	3		2		2			12	2	2	2	1		1	1		9
FRANCE				1		2		2		1	6	1		2		1	1		1	6

MATRIX DISPLAY CONTROL SYSTEMS

Controls for systems which visually display information received from another apparatus, where the visual image is produced by a display panel having a matrix type of construction. These inventions involve electronic circuits for controlling the application of information signals to matrix display panels which usually form the read out portion of a larger system such as a computer or calculator; the computer or calculator being the apparatus supplying the information to be displayed. (Class 340, subclass 324M)

Average Annual Activity Indices (1973-75)

Growth	53.8%	Corporate Owned	94.3%
Foreign Share	36.2%	Government Owned	1.0%

Recent Activity

Improved marketability of devices equipped with digital displays has promoted interest in this area of technology. Most of the recent activity has been directed towards circuits to control liquid crystal (nematic crystal) and plasma (gaseous discharge) panels and circuits to improve contrast and eliminate cross-talk. However, control circuits for many diverse display panels can be found here, ranging from electro-mechanically operated openings (e.g. shutters) to light emitting diodes and reversible electrochemical reactions. The following patents are examples of recent developments in this area since April 1975:

LIQUID CRYSTAL (NEMATIC CRYSTAL) DISPLAY

3,895,372 - (Kaji et al, Hitachi, Ltd.) - Decreases the response time of a display excited with time-division signals.

3,921,162 - (Fukai et al, Matsushita Elec. Indust. Co.) - Discloses temperature compensation by varying the amplitude or driving signal frequency of a display.

GAS DISCHARGE (PLASMA) DISPLAY

3,877,006 - (Portman et al, Thomas-CSF-) - Discloses the operation of display cells with a two part driving signal.

3,895,371 - (Kaji et al, Hitachi, Ltd.) - Discloses operating display cells by simultaneously applying a subsidiary discharge signal and a main discharge signal to facilitate a main discharge.

3,903,516 - (Mauro, IBM Corp.) - Discloses detailed control logic for operating a display panel.

3,911,422 - (McDowell et al, IBM Corp.) - Discloses increasing display intensity by shifting information (e.g. horizontally) to ignite adjacent cells.

OTHER

3,883,862 - (Nishizawa et al, Semicond. Research Found. & Hitachi, Ltd.) - Discloses using an active transmission line to switch and supply signals to the display.

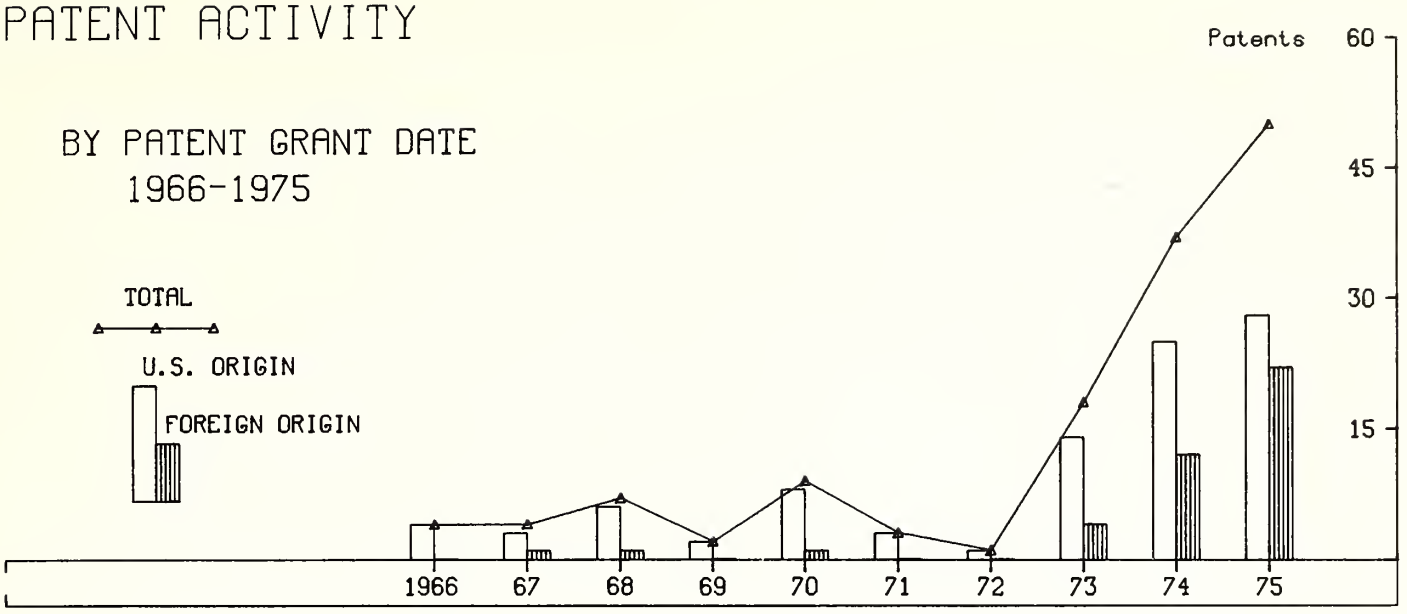
3,895,373 - (Freiser et al, IBM Corp.) - A display cell is selectively excited by adjusting the phase of the voltage on the row and column drive lines.

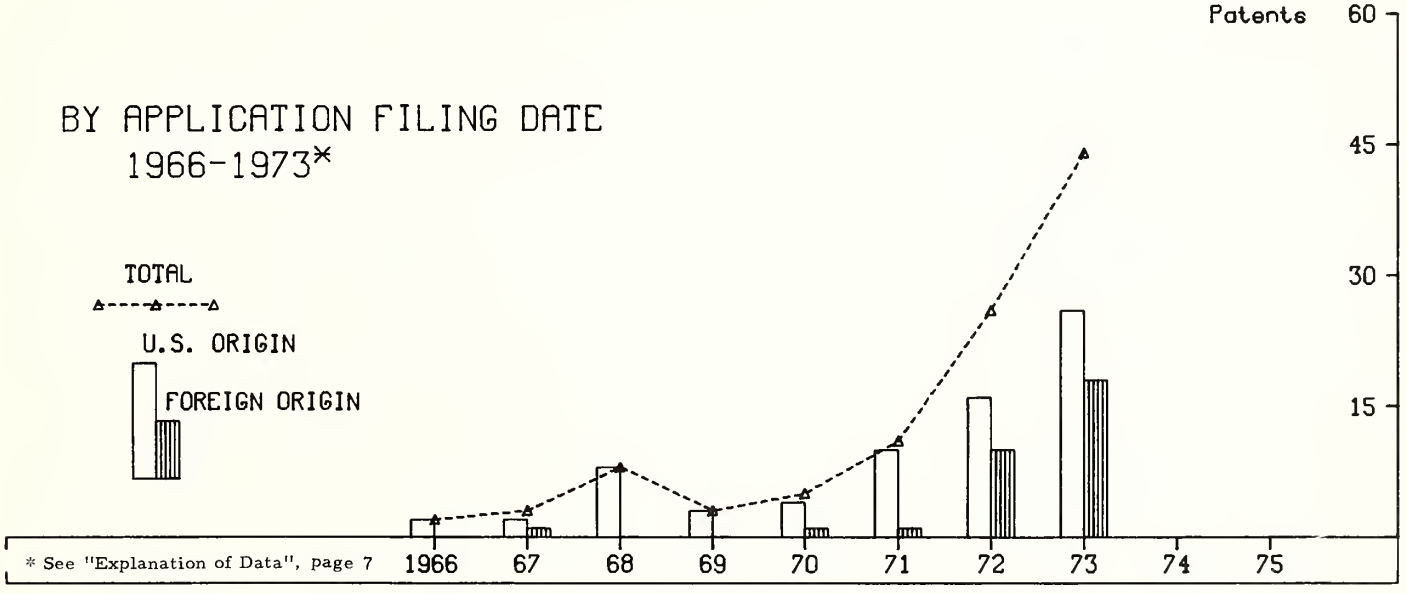
3,911,417 - (Stifle, Univ. of Ill. Found.) - Control circuits are disclosed which display information by using a line generator generating straight line segments.

3,911,423 - (Arndt et al, Northern Elec. Co.) - Describes a method for pulsing a photoconductive semiconductor (electrically or optically) to turn on a light emitting device (LED) which maintains itself on by supplying light to the photoconductive semiconductor.

3,913,090 - (Fischer, U.S. Army) - Discloses a system which uses column and row bucket brigade shift registers to operate an amorphous semiconductor-electroluminescent display panel.

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	4	4	7	2	9	3	1	18	37	50	135	2	3	8	3	5	11	26	44	102
UNITED STATES	4	3	6	2	8	3	1	14	25	28	94	2	2	8	3	4	10	16	26	71
TOTAL FOREIGN		1	1		1			4	12	22	41		1			1	1	10	18	31
JAPAN			1					1	5	14	21							4	11	15
NETHERLANDS									1	3	4								2	2
UNITED KINGDOM								1	3		4							2	2	4
FRANCE									2	2	4							3	1	4
GERMANY								1		2	3					1			2	3
ITALY		1			1						2		1							1
CANADA									1	1	2							1		1
IRELAND								1			1						1			1

MULTIPLEXED LOOP TELECOMMUNICATION SYSTEMS

Systems for providing simultaneous transmission of more than one message through a communication loop. Stations are positioned along the loop and each station's signal (transmitted or to be received) is identified by its location in a particular time slot (commonly of microseconds duration). These systems are utilized, for example, in telephone concentrators and centralized credit systems having terminals at participating retail stores. (Class 179, subclass 15 AL)

Average Annual Activity Indices (1973-75)

Growth	28.1%	Corporate Owned	91.9%
Foreign Share	21.0%	Government Owned	0.0%

Recent Activity

From fixed time slot assignment of messages, the technology has progressed to variable time slot allocation and other adaptive systems which are responsive to demand criteria. In addition, loops have been combined to communicate with each other, and arranged in a hierarchial order. Two basic types of loops can be found: (1) true loops, which are circular, having stations positioned along the loop with messages flowing in one direction around the loop; and, (2) folded loops, which consist of a line, having stations positioned along the line with messages flowing from one end of the line to the other and back. The following patents disclose various systems developed since February, 1974:

True Loops

3,790,717 - (Abramson et al, Adaptive Technology, Inc.) - A telephone system wherein each telephone unit can independently communicate with another without requiring a central control processor.

3,870,825 - (Roberts et al, Engineering Devices Co.) - An educational system having a central facility storing instructional programs which allows students at different locations to select individual programs.

3,879,582 - (White et al, RCA Corp.) - A digital data communication system with data processors that can handle a plurality of synchronous data rates including techniques to accomodate asynchronous data rates.

3,890,471 - (Hachenburg, Bell Telephone Laboratories, Inc.) - An interloop communication terminal which allows transmission of messages between loops and storage of messages when the desired loop is busy.

3,904,829 - (Martin et al, Control Data Corp.) - Discloses a system having message terminals and a central terminal positioned along two concentric loops. The central terminal uses one loop for inserting data and the other loop for extracting data.

3,919,483 - (Gindi et al, IBM Corp.) - A data processing system containing loop subsystems which are serially connected into a chain forming a large loop.

3,919,484 - (Maxemchuk, RCA Corp.) - A data processor loop controller which retimes loop signals and uses an adjustable time delay.

3,925,621 - (Collins et al, Arthur A. Collins, Inc.) - A loop build-out buffer connected in parallel with one digital switching node for transferring information between switching nodes. Multiplexing and swtiching functions are integrated into common equipment eliminating the need for separate multiplex systems.

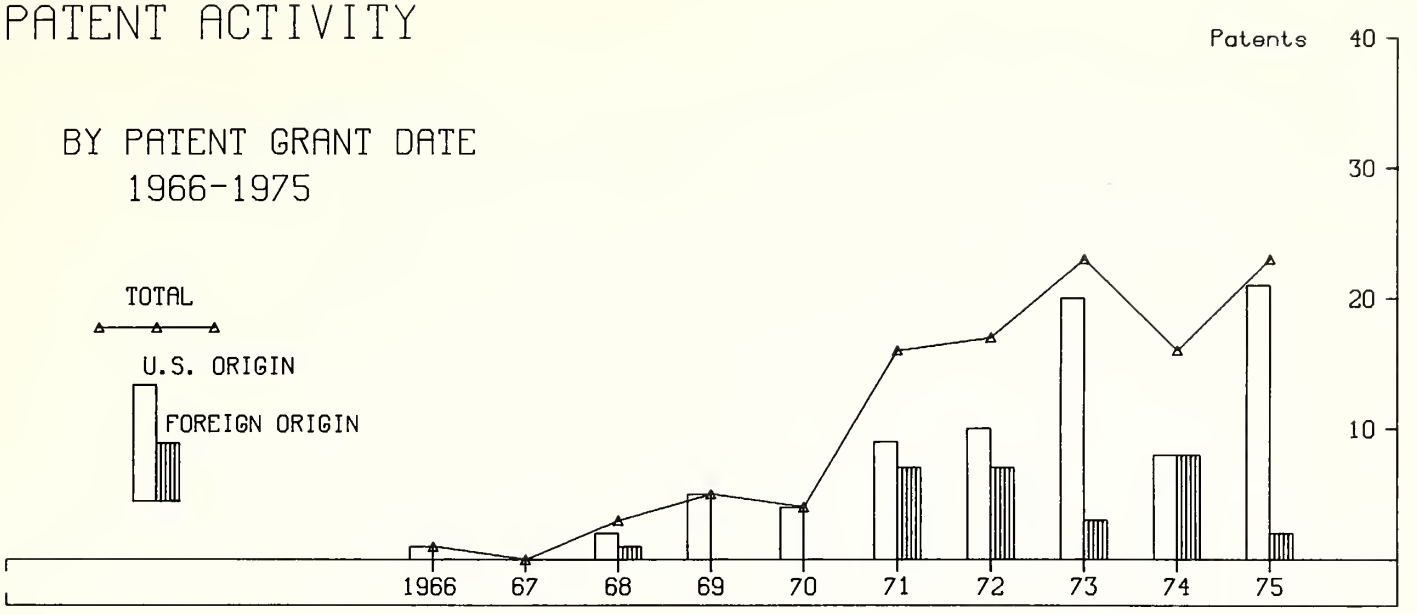
Folded Loops

3,859,465 - (Schenkel et al, Licentia Patent-Verwaltungs G.m.b.H.) - Branch loops connected to each other through a plurality of nodes; a test block signal is used to avoid a message on one loop encountering an occupied time slot on another branch loop.

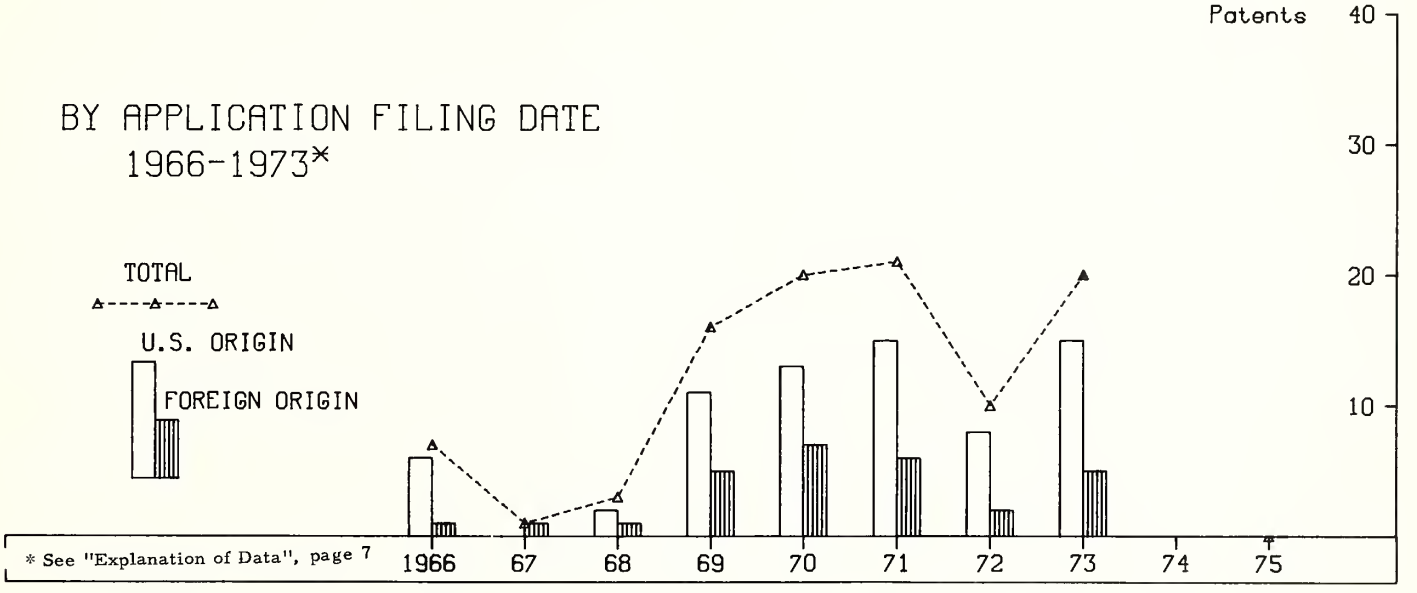
3,924,077 - (Blakeslee) - Telephone system without fixed time slot assignment, allowing several times more telephones on a line than time slots available.

PATENT ACTIVITY

BY PATENT GRANT DATE 1966-1975



BY APPLICATION FILING DATE 1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	1		3	5	4	16	17	23	16	23	108	7	1	3	16	20	21	10	20	98
UNITED STATES	1		2	5	4	9	10	20	8	21	80	6		2	11	13	15	8	15	70
TOTAL FOREIGN			1			7	7	3	8	2	28	1	1	1	5	7	6	2	5	28
UNITED KINGDOM						6	1		1		8		1	1	4	1		1		8
FRANCE			1			1	1		1	1	5	1				2			2	5
JAPAN							1	2	2		5						5			5
GERMANY									2	1	3							1	2	3
SWITZERLAND									2		2						1		1	2
CANADA							2				2				1	1				2
SWEDEN							1				1					1				1
ITALY								1			1					1				1
AUSTRALIA							1				1					1				1

PROGRAMMED TESTERS FOR DATA PROCESSING SYSTEMS

Programmed testing devices for locating malfunctions in the operation of, or an error in the results produced by, an electronic digital data processing system. Types of systems tested include calculators (registers and keys or equivalent means for operating them) together with their necessary auxiliary devices, (e.g. printers displays, bells) which perform various mathematical operations. The testing system generates a predetermined pattern of signals, applies them to the appropriate terminals of the system being tested, and analyzes the test results. (Class 235, subclass 153AC)

Average Annual Activity Indices (1973-75)

Growth	30.4%	Corporate Owned	93.9%
Foreign Share	24.6%	Government Owned	3.1%

Recent Activity

Activity has centered on automatic testing of integrated circuit systems which eliminates the need for operator control. Some testers are permanently built into the digital data processing system and periodically run automatic tests. Other testers can be connected to all available terminals on the system and can activate different terminals for different tests. Also found here are universal test systems which can be used on a variety of digital data processors, and test systems for design concepts of proposed digital data processors systems. The following patents, issued since February, 1975, disclose recent activity in this area:

3,867,618 (Oliver et al, IBM Corp.) - A program controlled test system for detecting and locating faults which may occur due to power supply loading conditions in a digital data processing system.

3,873,818 (Barnard, IBM Corp.) - An electronic tester for testing electronic devices having high circuit density, which makes efficient use of its own memory in storing a large number of test patterns. Where similar test words exist, one complete word is stored along with selected portions of the remaining similar words. Reconstruction of each descrete word is provided for.

3,892,955 (Maejima, Takeda Riken Kogyo Kabushiki Kaisha) - Discloses a testing system which stores reference data in a buffer memory and later compares the stored reference data to the output of the storage unit being tested. This permits a later comparison to be effected when access time to the tested store is relatively long, while allowing the tester concurrently to access another location.

3,898,449 (Sanabria, GTE Automatic Electric Laboratories Inc.) - Discloses an arrangement and method for using a magnetic tape to introduce test patterns into a core memory. The patterns are used for determining internal failures within the core memory or its associated logic circuits.

3,904,861 (McNamara, Digital Equipment Corp.) - A testing circuit for checking plug-in units of a digital data processing system. The testing circuit is plugged into a connector which normally holds the unit being tested, and the unit being tested is plugged into the testing circuit.

3,919,533 (Einolf et al, Westinghouse Electric Corp.) - A fault indicating system which tests the operation of a digital processing system. The processing system periodically generates a predetermined coded output when it is functioning properly. A fault indication is inhibited as long as the coded output is periodically generated.

3,922,537 (Kackson, Instrumentation Engineering, Inc.) - Discloses a multiplex test apparatus for selectively interconnecting peripheral measurement (e.g. voltmeter) and stimulus (e.g. voltage source) devices to a unit under test. These interconnections operate automatically under programmed computer control.

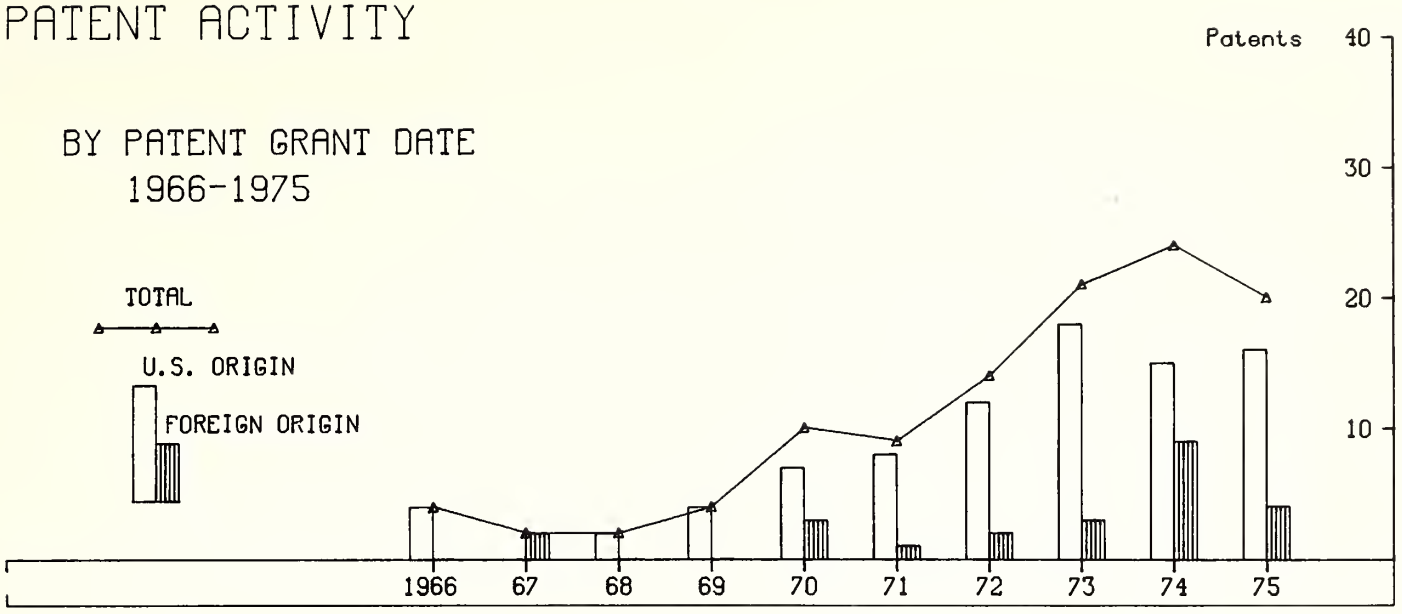
3,924,109 (Jhu et al, Technology Marketing Inc.) - A testing system for printed circuit boards. The tester has a changeable storage element that defines the sequence of test signals used and pin connections for access to the board being tested. The tester compares the output signals obtained with the anticipated output signals.

3,927,310 (D'Anna et al, U.S. Air Force)- Discloses a device for testing and isolating faults in digital equipment containing multiplexed data ports.

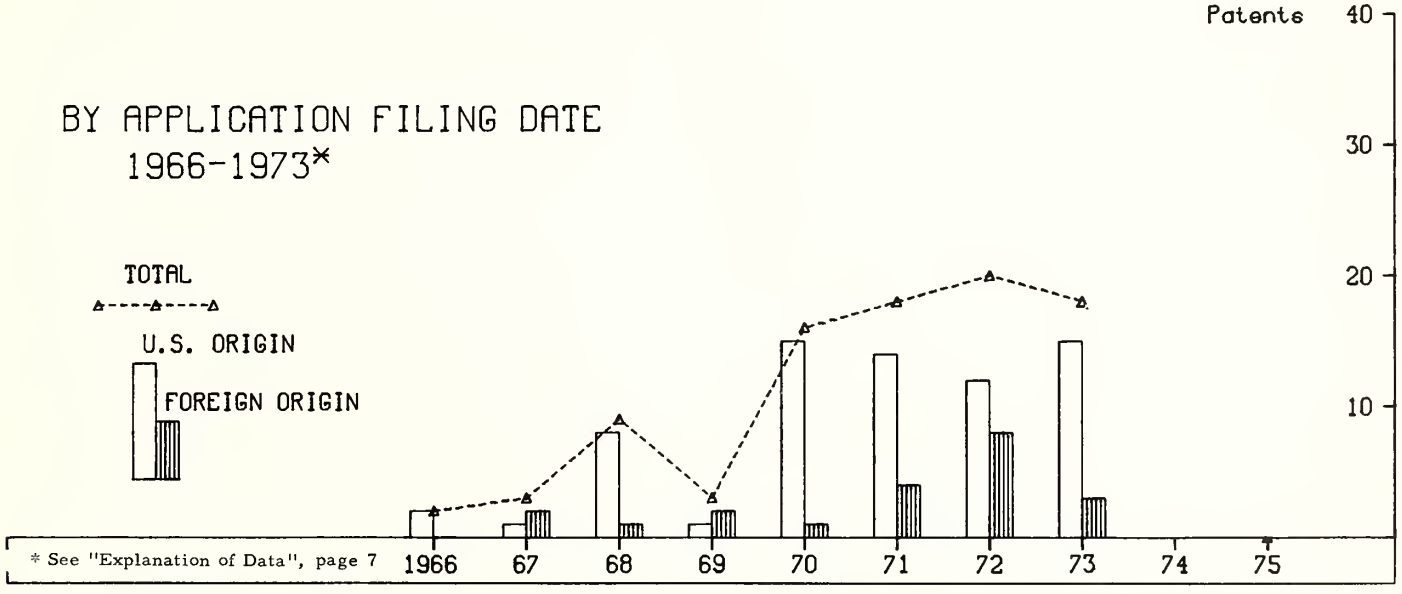
3,931,506 (Borrelli et al, Zehntel, Inc.) - Discloses a method and apparatus for the automatic, programmed, in-circuit testing of components.

PATENT ACTIVITY

BY PATENT GRANT DATE 1966-1975



BY APPLICATION FILING DATE 1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	4	2	2	4	10	9	14	21	24	20	110	2	3	9	3	16	18	20	18	89
UNITED STATES	4		2	4	7	8	12	18	15	16	86	2	1	8	1	15	14	12	15	68
TOTAL FOREIGN		2			3	1	2	3	9	4	24		2	1	2	1	4	8	3	21
GERMANY		1						1	6	1	9						2	5	1	8
JAPAN					1		1	2		2	6			1		1	2	1		5
UNITED KINGDOM					2					1	3		2					1		3
ITALY							1		1		2				1				1	2
CZECHOSLOUVAKIA									1		1							1		1
USSR						1					1				1					1
BELGIUM									1		1								1	1
SWITZERLAND		1									1									

REGULATED RADIANT ENERGY SYSTEMS

Systems containing electric lamps and electric space discharge devices combined with an electric circuit for regulating the amount of radiant energy generated. The circuit employs a radiant energy sensitive device arranged to receive a portion of the energy generated by the device being regulated. (Class 315, subclass 151)

Average Annual Activity Indices (1973-75)

Growth	6.2%	Corporate Owned	86.5%
Foreign Share	67.6%	Government Owned	0.0%

Recent Activity

Activity has centered on highly competitive electronic photo flash systems. Circuits are provided which terminate a flash when a sufficient amount of light is reflected from the object being photographed. Usually this circuit consists of an electronic switch arranged in series with a flash tube (series turn off circuit). This type of circuit conserves energy, usually stored in a capacitor, by allowing extra energy to remain in the capacitor for use in the next flash. Recycling time (recharging the capacitor to full voltage) is also reduced, allowing a more rapid succession of flashes. The following patents, issued since September, 1973, disclose some of the activity in this area:

3,758,817 (Elliott, Honeywell, Inc.) - A counter and plurality of silicon control rectifiers (electronic switches) sequentially connect each of a plurality of storage capacitors to a flash tube. When a predetermined quantity of light is reflected from a subject to be photographed, the counter is stopped and the flash tube is short circuited, dumping the remaining charge on only one capacitor. Recycling time is decreased by recharging each capacitor following its discharge into the flash tube.

3,774,072 (Ogawa, Honeywell, Inc.) - A photoflash system with a light sensitive device that is detached from both the camera and the flash device. The light sensitive device prevents flash termination by extraneous conditions (e.g. a flash from a different camera), being enabled only when its own flash tube has been fired.

3,780,340 (Munro, Analog Monitors, Inc.) - A light source having a self-regulating intensity control. A photosensitive element controls a switch which either energizes or de-energizes the light source depending on the level of light required.

3,864,601 (Schneider, Rollei-Werke Franke & Heidecke) - A photoflash system having a main storage capacitor and at least one additional storage capacitor to provide more energy when required. A photosensitive transistor, acting on reflected light, serves to control both the operation of the additional storage capacitor and flash tube termination.

3,869,642 (Sabanci, Rollei-Werke Franke & Heidecke) - Discloses a control circuit acting on reflected light that reduces the response time required to terminate a photoflash. This circuit is particularly useful in close-up photography.

3,875,471 (Buck, Berkey Photo, Inc.) - The operation of a flash lamp is terminated when two signals are combined and they achieve a predetermined relationship. One signal is related to the intensity of reflected light and the other signal is related to a predetermined function of time.

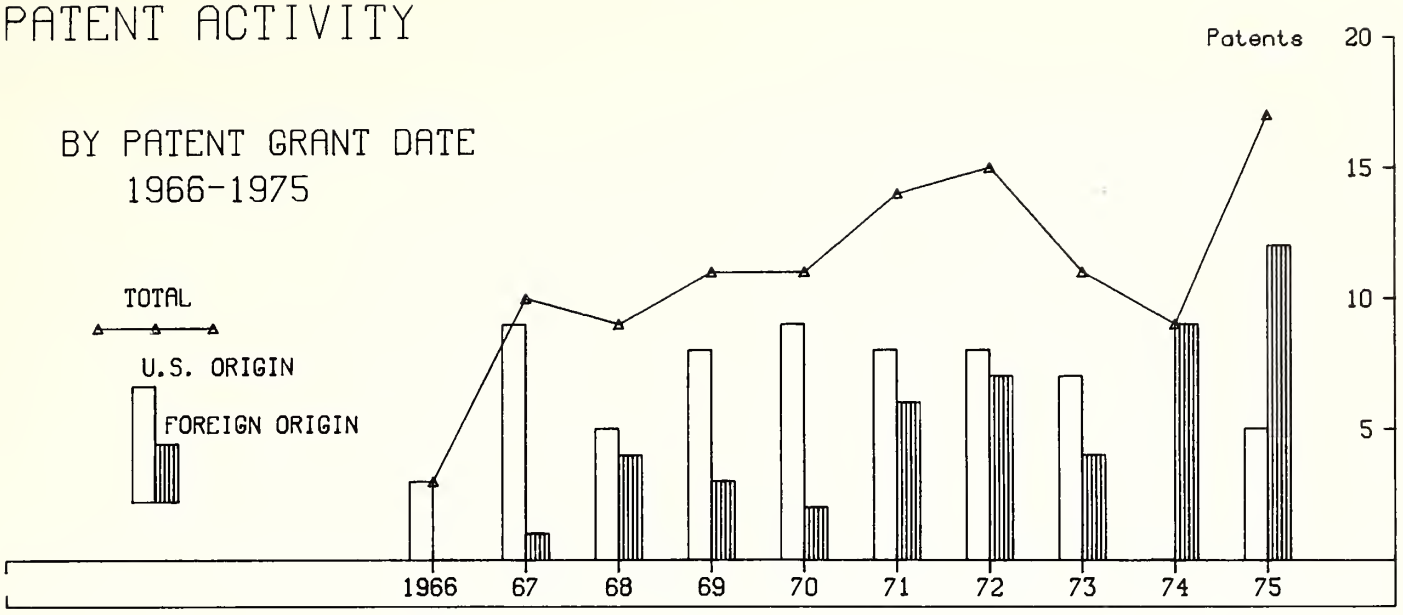
3,878,429 (Iwata) - A photosensitive device terminates a photoflash in response to reflected light by applying a voltage to a switch connected in series with the flash tube. The voltage is applied in the reverse direction to the forward voltage drop of the switch.

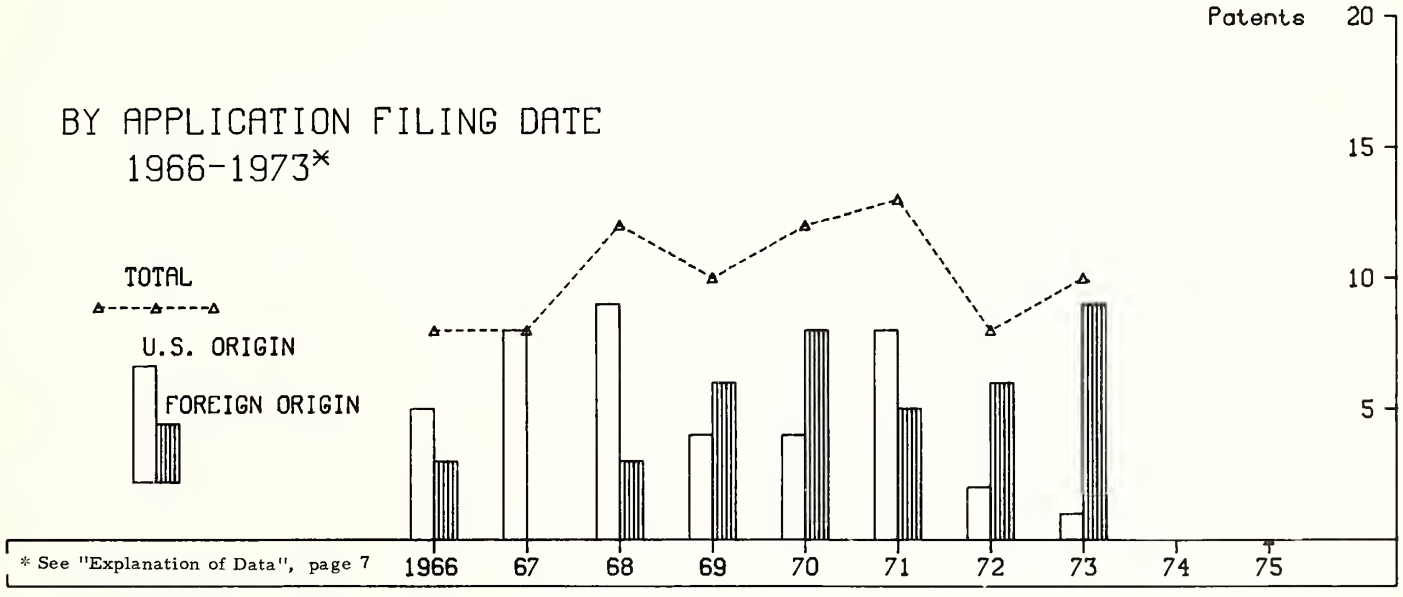
3,878,433 (Sato, Sato Koki Co., Ltd.) - A photoflash system in which the flash is terminated at a predetermined time after flash initiation. A timing circuit is included which may be activated by light originating from the flash tube.

3,896,333 (Nakamura, Canon Kabushiki Kaisha) - Discloses a series turn-off type photoflash termination circuit. Termination time may correspond to film sensitivity or the distance from a camera to an object. A discharge preventing capacitor is used for reliable start-up of the flash tube.

3,914,647 (Broekstra et al, Honeywell, Inc.) - A photoflash system with a light sensor that substantially precludes the generation of a false termination signal. Circuitry is included which renders the sensor incapable of generating a termination signal until after a predetermined amount of light has been received from the scene being photographed.

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	3	10	9	11	11	14	15	11	9	17	110	8	8	12	10	12	13	8	10	81
UNITED STATES	3	9	5	8	9	8	8	7		5	62	5	8	9	4	4	8	2	1	41
TOTAL FOREIGN		1	4	3	2	6	7	4	9	12	48	3		3	6	8	5	6	9	40
JAPAN						3	4	2	3	6	18			2	1	4	3	1	7	18
GERMANY			1		2	2	2	2	2	5	16	1			4	3	1	2	1	12
BELGIUM									4		4						1	3		4
NETHERLANDS		1	1				1				3					1				1
SWITZERLAND				2							2	2								2
SWEDEN				1							1			1						1
FRANCE										1	1								1	1
UNITED KINGDOM			1								1									
CANADA			1								1									
SPAIN						1					1				1					1

ELECTROMECHANICAL OSCILLATORS

A device for initiating and maintaining oscillations whose frequency is determined by an electromechanical resonator (e.g. a tuning fork, resonant spring, or vibrating filament driven by a solid state circuit). These oscillators are well suited for applications requiring low frequencies, and commonly form the heart of timing devices (e.g. watches), resonant filters, and optical choppers. Oscillators including piezoelectric crystal resonators as frequency determining elements are not included here. (Class 331, subclass 116M)

Average Annual Activity Indices (1973-75)

Growth	7.8%	Corporate Owned	90.3%
Foreign Share	74.2%	Government Owned	0.0%

Recent Activity

Recent efforts have concentrated on refining the electromechanical oscillators. Much of this work is directed to ways of compensating for environmental effects (e.g. mechanical shock and temperature) to obtain more accurate and stable oscillator frequencies and amplitudes; and methods for obtaining more efficient and physically smaller oscillators. Patents issued since April, 1972 include:

3,657,667 (Nishikubo et al, Citizen Watch Co., Ltd.) - Discloses a three arm mechanical vibrator with a piezo-electric element glued to each arm. The piezo-electric elements are connected in a manner to suppress spurious oscillation signals generated by outside forces, e.g. shocks in an automobile clock.

3,670,265 (Schmitt, Gehap Gesellschaft fur Handel und Patentverwertung mbH & Co. Kg) - Attaches small permanent magnets to the turning fork legs to synchronize the frequency of the electronic oscillatory circuit so that it corresponds to the natural frequency of the tuning fork. The moving magnetic field that is created affects the oscillation and drive coils allowing synchronization.

3,701,052 (Keller, ITT Industries, Inc.) - Provides a circuit for maintaining constant amplitude during changes in battery voltage and quick positional variations in an electromechanical oscillator containing only one driving coil (useful in wrist watches).

3,710,275 (Tanaka et al, Shigeru Kakubari) - Discloses a low frequency oscillator which uses the beat frequency produced by a pair of tuning forks. The forks, punched from a sheet of resilient metal, have a unitary structure. The frequency produced is stable to temperature variations.

3,727,151 (Koehler, Bulova Watch Co., Inc.) - Discloses an intergrated circuit operating in conjunction with an electromagnetic transducer which functions as the driving circuit for a tuning fork resonator.

3,729,691 (Beiswinger et al, Verta-Tronics, Inc.) - Discloses a transistor circuit connected to an oscillator consisting of an armature coil mounted in a magnetic field between two resonant springs which alternately expand and contract. The transistor circuit reduces the number of electrical connections required to the oscillator making it less susceptable to broken connections due to mechanical vibration.

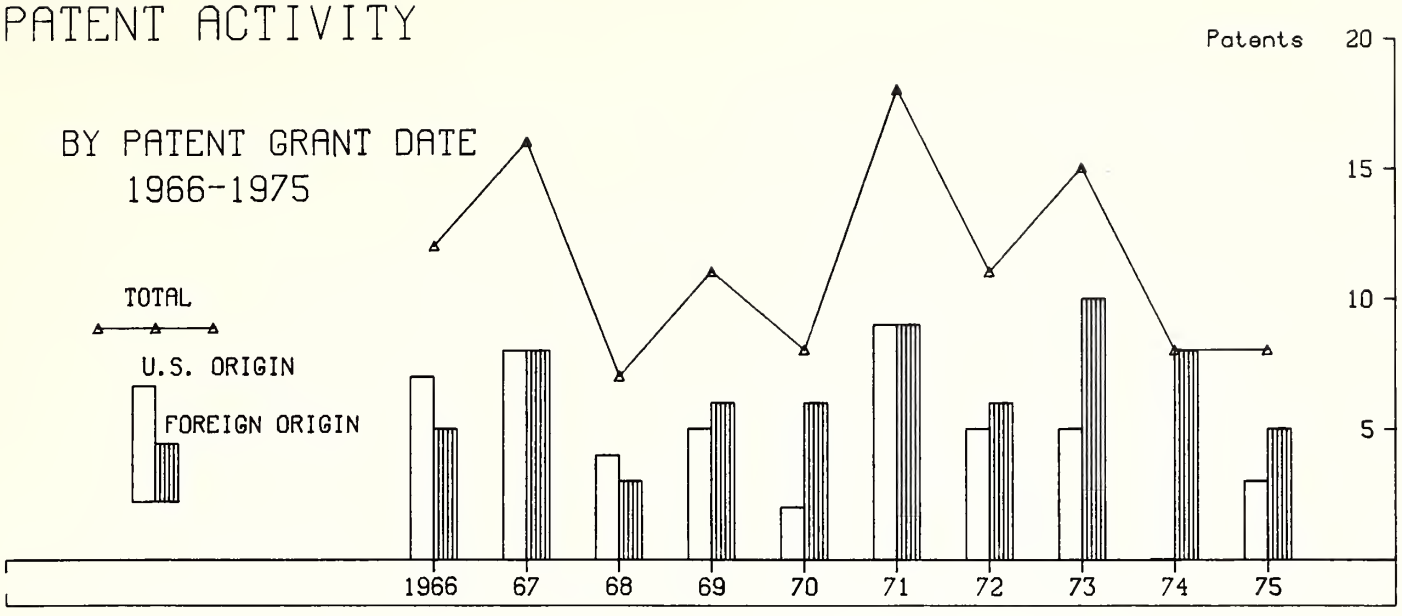
3,742,385 (Keller et al) & 3,731,229 (Keller, ITT Industries) - Discloses a transistor circuit in a single coil electro-mechanical oscillator which alleviates unfavorable regenerative feedback by avoiding DC coupling between the driving transistor and the control transistor.

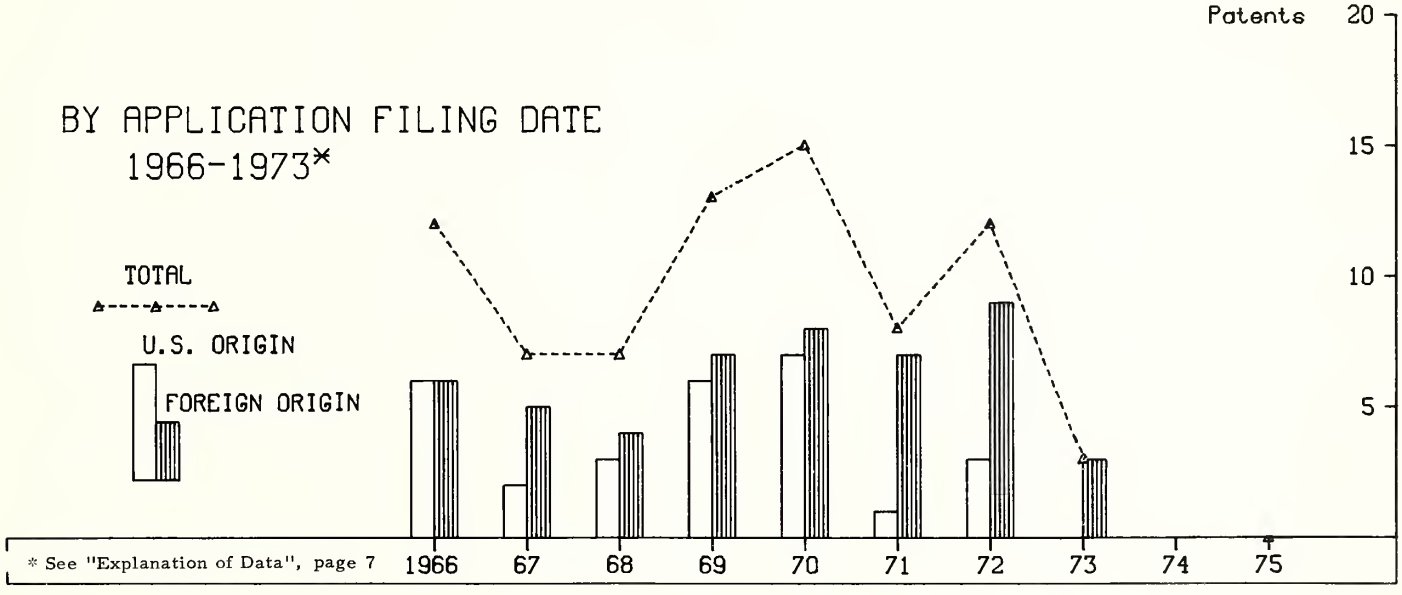
3,787,783 (Ketterer) & 3,713,047 (Ketterer, Firma S.L. Kroewerath & Co.) - Discloses a timing device employing an oscillating magnet, and a transistor control circuit having electrodynamic power pulses and pick up pulses.

3,805,190 (Berlin et al) - Discloses a tuning fork oscillator which utilizes a photo-electric device to measure oscillation and provide a positive feedback.

3,818,376 (Keller et al, ITT Industries) - Discloses a circuit for synchronization of an electromagnetic balance type oscillator system which maintains constant amplitude and corrects for even extreme changes in the natural frequency. The synchronization circuit employs two successive drive pulses and a divided frequency crystal oscillator.

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	12	16	7	11	8	18	11	15	8	8	114	12	7	7	13	15	8	12	3	77
UNITED STATES	7	8	4	5	2	9	5	5		3	48	6	2	3	6	7	1	3		28
TOTAL FOREIGN	5	8	3	6	6	9	6	10	8	5	66	6	5	4	7	8	7	9	3	49
GERMANY	1	5	2		3	2	2	7	3	1	26	1	1	2	2	2	6	3	1	18
SWITZERLAND	3			3	1	4	1	1	2		15	2	1	1	3	2		3		12
JAPAN	1	1	1	2	2	2	3	2	2	3	19	3	2	1	1	4	1	2	1	15
FRANCE		1				1				1	3				1				1	2
USSR				1					1		2		1					1		2
ITALY		1									1									

ELECTROCARDIOGRAPH ELECTRODES

Sensing devices, used with electrocardiographs, that respond to changes in electrical potential occurring in the body due to a heart beat. Typically they consist of electrically conductive pads impregnated or coated with conductive gels. They are usually attached to the skin with adhesive material or straps. (Class 128, subclasses 2.06 E).

Average Annual Activity Indices (1973-75)

Growth	24.3%	Corporate Owned	58.5%
Foreign Share	9.4%	Government Owned	3.8%

Recent Activity

Recent patent activity has been varied, however, much of it has centered on development of disposable, stronger, and more conductive electrodes. Patents, issued since January 1974, include:

3,788,317 (McCormick, Pelam Inc.) - An electrocardiograph electrode consists of a dry, absorbent, salt-impregnated pad which receives water from an adjacent cup made of electrically conductive material. When wet, the absorbent pad expands and forms an electrically conductive bridge between a person's skin and the cup.

3,805,769 (Sessions) - An electrocardiograph electrode equipped with an adhesive, a pad containing conductive gel, and a protective cover. The cover, removable at the time of use, consists of an annular spacing ring encircling the gel and a protective sheet structure to seal the gel and adhesive to prevent gel deterioration over long time periods.

3,862,627 (Hans Sr.) - An electrocardiograph electrode operates on a vacuum suction principle. A resilient bulb is compressed and an attached cup-shaped member is placed on the skin so that, when the bulb is released, the member is placed in a firm yet comfortable holding state.

3,862,633 (Allison et al) - An electrocardiograph electrode has a container employing a porous diaphragm for storing an electrolyte. A metallic plug inserted in the container is removed for filling the container with electrolyte and reinserted as a seal and electrode output terminal. Adhesive structure adjacent the container bonds the electrode to the skin allowing electrolyte to permeate the diaphragm and unite with skin fluids.

3,868,947 (Holsinger, U.S.A.) - An electrocardiograph electrode employing two separate transmitter electrodes each having a central conducting surface, an outer conducting surface and an insulating barrier concentrically arranged. Two signals are obtained from the transmitter electrodes and fed to a differential amplifier which provides a single output difference signal for analysis.

3,882,846 (David et al) - An electrocardiograph electrode which, upon contacting the skin, capacitively couples electrical signals from the skin through an impedance transformer. The impedance transformer employs an operational amplifier with field effect transistor (F.E.T.) input stage.

3,882,853 (Gofman et al, Cardiodynamics Inc.) - An electrocardiograph electrode for long term application to the skin which consists of spongelike material impregnated with conductive paste. The material is attached to the skin in a firm yet comfortable manner. This electrode minimizes artifact noise which accompanies body movements.

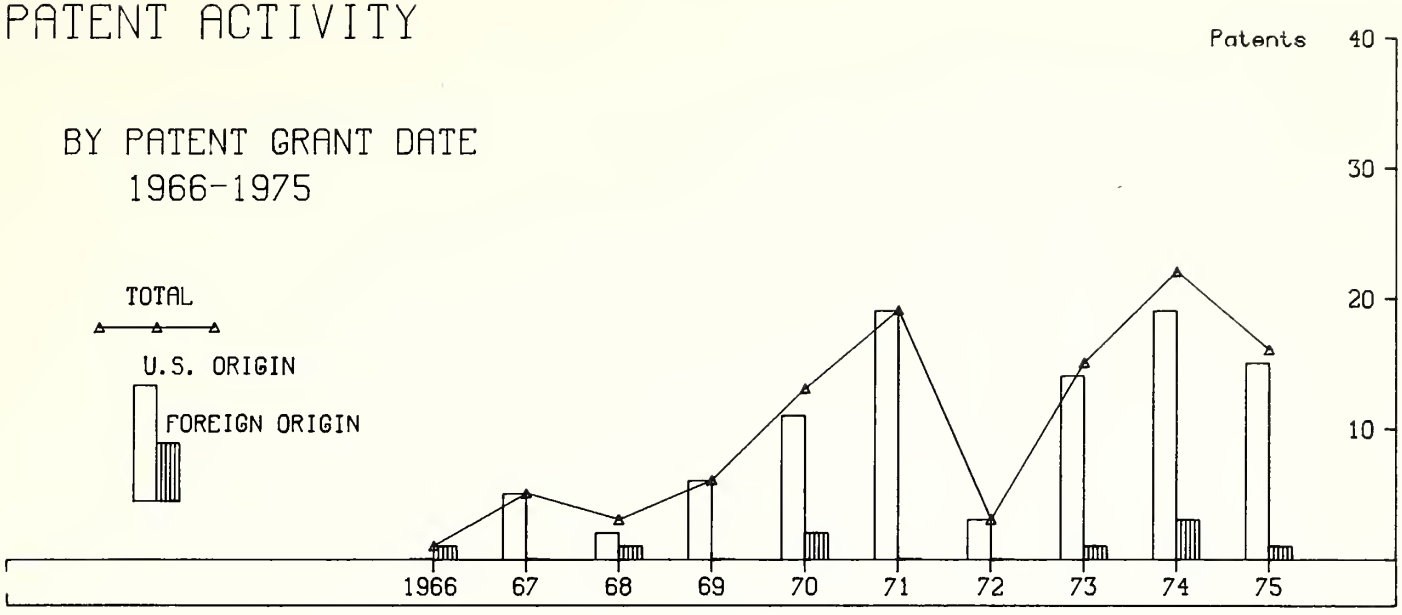
3,888,240 (Reinhold Jr. et al, Survival Technology Inc.,) - Discloses for use on infants, a disposable cardiac monitoring electrode assembly which consists in part of a pad of very fine, open pore polyurethane upon which the infant is placed. Plural carbon powder-impregnated sheet electrodes are placed on the pad to contact the skin. The pad has straps which attach the assembly to the infant's body in a way intended to minimize discomfort.

3,911,906 (Reinhold Jr., Survival Technology Inc.) - Discloses an electrocardiograph electrode which employs a carrier layer having a thin flexible layer of pressure-sensitive adhesive and fine electrically conductive particles dispersed throughout. The adhesive layer provides a tacky skin-engaging surface in addition to allowing conductivity from the skin to a terminal structure.

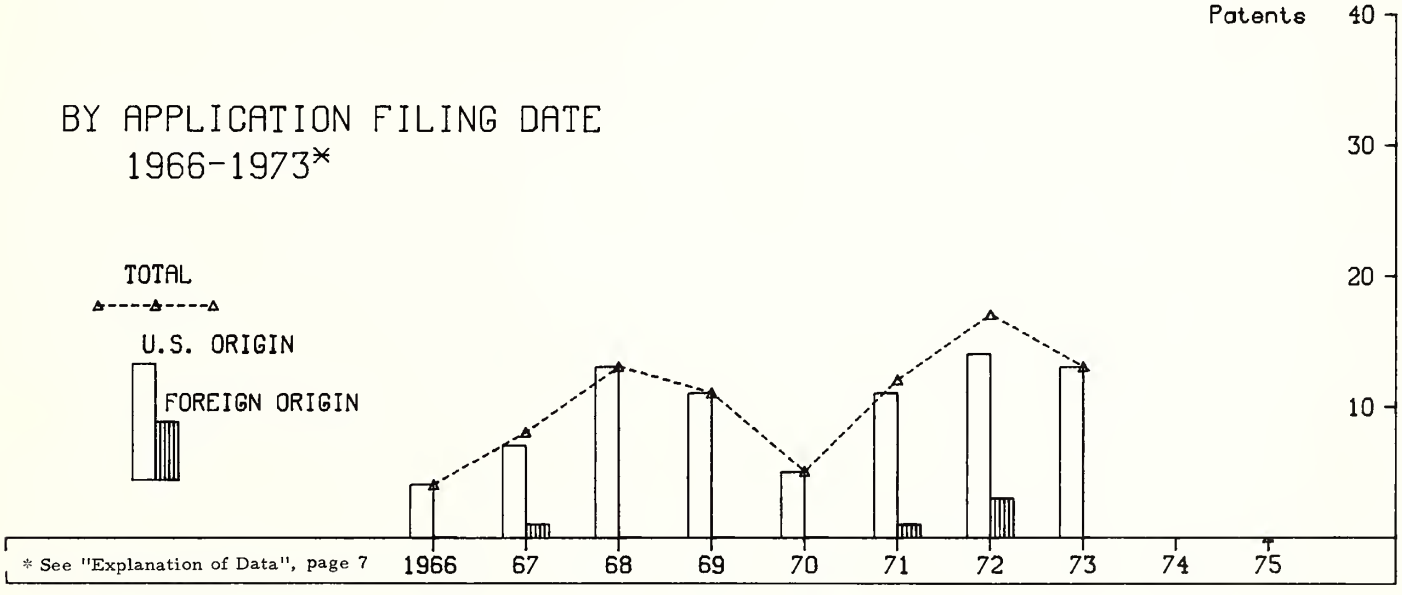
3,923,042 (Hajdu et al, Medicor Muvek) - An electrocardiograph electrode which consists of a silver cup-like member containing a porous structure of silver grains bonded to the member. Free surfaces of the silver grains are coated with silver chloride. A porous foam disc saturated with chloride ion gel in contact with the grain structure is held to the skin when the electrode is adhesively attached to the body.

PATENT ACTIVITY

BY PATENT GRANT DATE
1966-1975



BY APPLICATION FILING DATE
1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	1	5	3	6	13	19	3	15	22	16	103	4	8	13	11	5	12	17	13	83
UNITED STATES		5	2	6	11	19	3	14	19	15	94	4	7	13	11	5	11	14	13	78
TOTAL FOREIGN	1		1		2			1	3	1	9		1				1	3		5
GERMANY					1			1	1		3		1				1	1		3
HUNGARY									1	1	2							1		1
USSR									1		1							1		1
CZECHOSLOVAKIA			1								1									
UNITED KINGDOM					1						1									
CANADA	1										1									

UNDERWATER HOLOGRAPHY

Communication of three dimensional information between geologically spaced locations, at least one of which is under water. Compression waves are used to transmit the information underwater. These techniques are applied to sonar systems and mapping of the ocean floor. (Class 340, sublcass 5H)

Average Annual Activity Indices (1973-75)

Growth	19.5%	Corporate Owned	82.2%
Foreign Share	35.6%	Government Owned	8.9%

Recent Activity

An early patent in this field which discloses the basic concepts of underwater holography was granted in 1967 (3,400,363-Silverman, Pan American Petroleum Corp.). Since then, efforts in this area have been directed towards improving signal processing techniques. Patents, issued since November 1973, include:

3,771,116 - (Farrah, The Bendix Corp.) - Increases hologram quality and aperture size by using an array of acoustic transmitters or a single transmitter at different frequencies.

3,789,354 - (Sternberg et al, United States) - Discloses a passive holography system involving imaging an object which is, itself, a source of radiation (e.g. acoustic) with no energy source integral to the holographic system.

3,805,225 - (Bossaert et al) - Discloses reducing speckle in the reconstructed image by modulating an ultrasonic generator at a low frequency.

3,818,427 - (Pekan et al, Siemens Aktiengesellschaft) - Improves signal to noise ratio when recording scanned rows by displacing every second row with respect to every first row.

3,829,827 - (Ernvein, Thomson-CSF) - Discloses a system for optical reconstruction of an acoustic hologram formed at the surface of a fluid.

3,836,950 - (Bherta et al, TRW Inc.) - Monitors individual constituents of differing acoustical transparency in a multi-constituent flow (e.g., liquid and gas or vapor through a conduit),

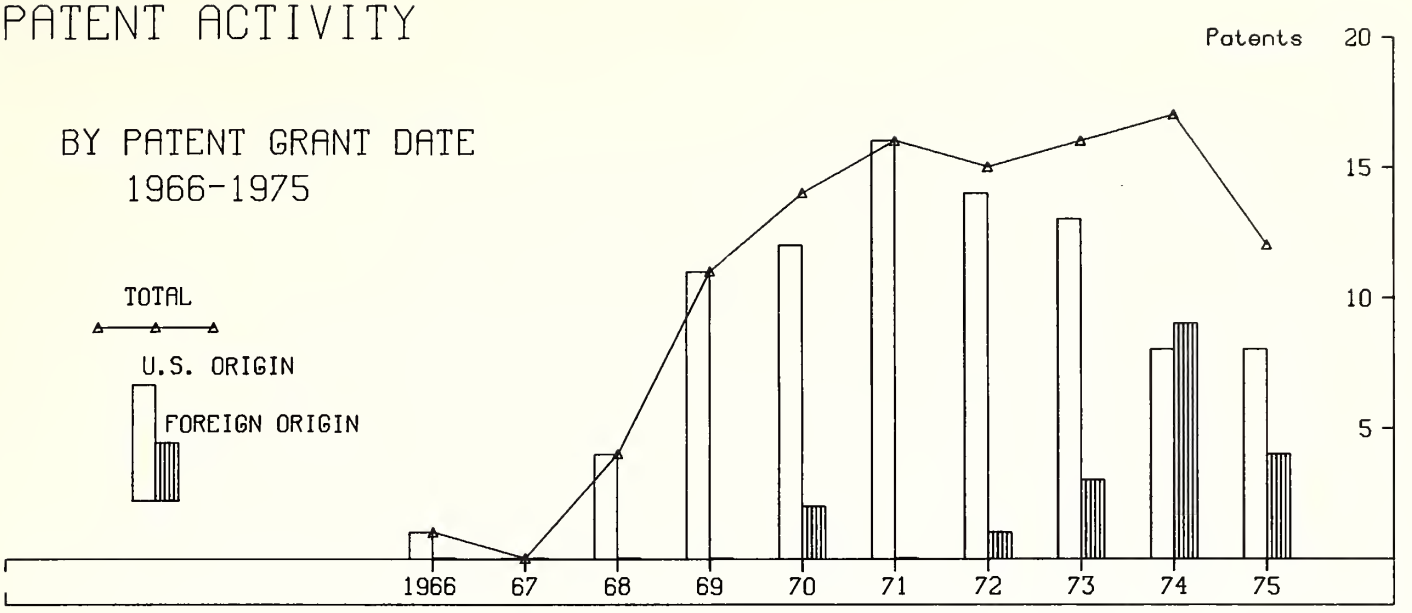
3,849,758 - (Pfeifer, The Bendix Corp.) - Prepares binary acoustic holograms with the use of a phase related blanking signal.

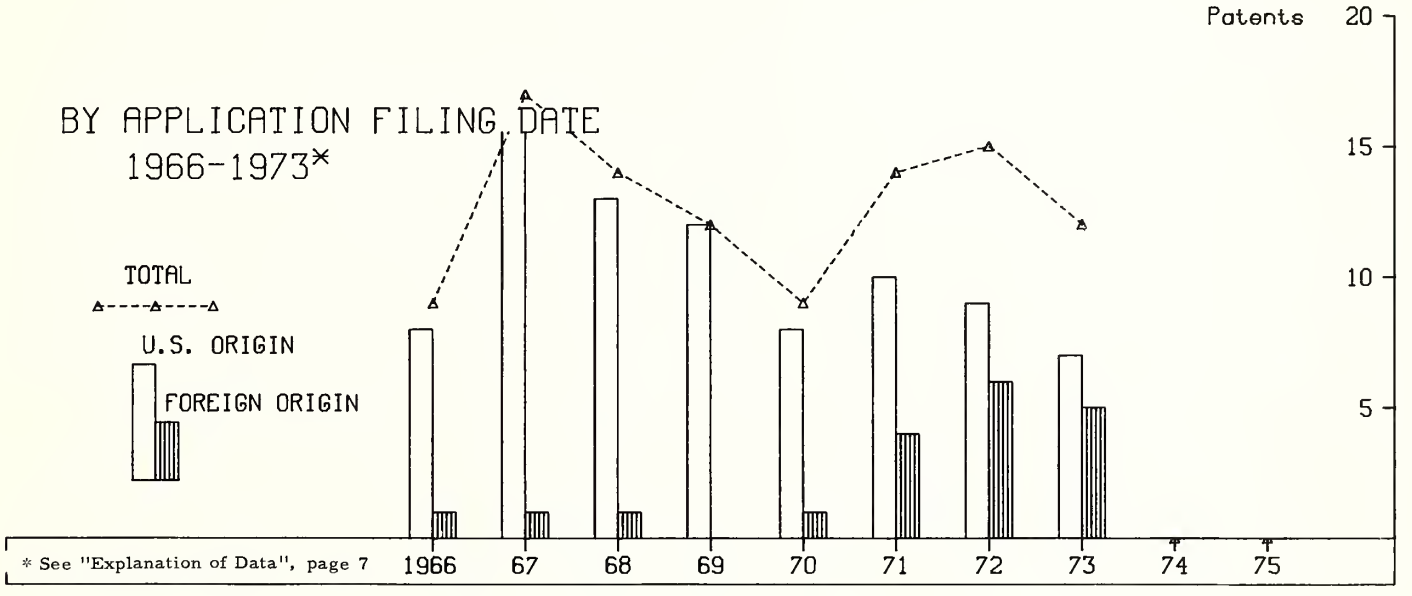
3,864,665 - (Pekan, Siemens Aktiengesellschaft) - Improves signal to noise ratio by recording each scanned row twice.

3,889,226 - (Hildebrand, Battelle Development Corp.) - Uses sector or angular scanning to produce a distortion to counteract distortion due to wavelength disparity.

3,895,341 - (Pekan, Siemens Aktiengesellschaft) - Discloses a system for aberration-free optical reproduction whereby image distance and image enlargement are independent of object distance.

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	1		4	11	14	16	15	16	17	12	106	9	17	14	12	9	14	15	12	102
UNITED STATES	1		4	11	12	16	14	13	8	8	87	8	16	13	12	8	10	9	7	83
TOTAL FOREIGN					2		1	3	9	4	19	1	1	1		1	4	6	5	19
FRANCE							1		5	1	7					1		4	2	7
GERMANY									3	2	5						1	1	3	5
SWEDEN					1				1		2			1				1		2
UNITED KINGDOM					1					1	2	1	1							2
CANADA								1			1						1			1
JAPAN								1			1						1			1
NEW ZEALAND								1			1						1			1

STILL CAMERAS WITH ELECTRIC FILM ADVANCE

Cameras for still picture photography which employ an electric motor to advance the film. Usually, the motor is activated by the shutter release mechanism to permit sequential exposure of succeeding portions of film. (Class 354, subclass 173)

Average Annual Activity Indices (1973-75)

Growth	10.3%	Corporate Owned	89.7%
Foreign Share	86.2%	U.S. Government Owned	0.0%

Recent Activity

Recent efforts are directed toward: improving synchronism of the automatic electric film advance systems with shutter operations; providing improved electronic control circuitry for accurate control of windup speed and braking action; and, employing power saving techniques to reduce the number and size of the battery power supplies required. The following patents, issued since October 1973, disclose examples of still cameras employing electric film advance:

3,763,755 (Kuramoto et al, Minolta Camera Kabushiki Kaisha) - A camera employs two independent power sources for exposure control and film advance-shutter cocking operation, respectively. An easily replaceable, relatively large voltage battery powers the film advance motor and shutter cocking mechanism. A small, constant voltage-current characteristic battery powers the exposure control mechanism.

3,813,681 (Sahara, Minolta Camera Kabushiki Kaisha) - Discloses a camera having an electric motor activated film drive which employs circuitry for timed exposure that prevents the winding of the film after the operation of the shutter if the luminosity of a subject is too low.

3,846,812 (Biber, Polaroid Corp.) - A camera employing an electronic flash system has a control system which sequentially: 1) triggers the flash unit to make an exposure; 2) initiates the operation of the film transport motor; and, 3) recharges the flash unit after the motor has ceased. This permits a single power source to be used for these operations since the demand for power at any one time is reduced.

3,878,546 (Adamski, Roller-Werke Franke & Heidecke) - Discloses a roll film camera with electric motor film advance and a control circuit responsive to the presence or absence of film in the camera. This circuit disables the film advance motor when no film is present to avoid unnecessary power drain. Also, the extent of winding movement is adjustable to the length of film used.

3,882,515 (Mueller, Bell and Howell Company) - A cartridge loaded camera employing electric motor film advance has a mechanism to set the shutter following rather than concurrent with film wind-up in order to enable reduction of motor and power pack size. Also, a mechanical interlocking mechanism is used to prevent accidental actuation of the camera control button until each portion of the camera cycle is performed in its proper sequence.

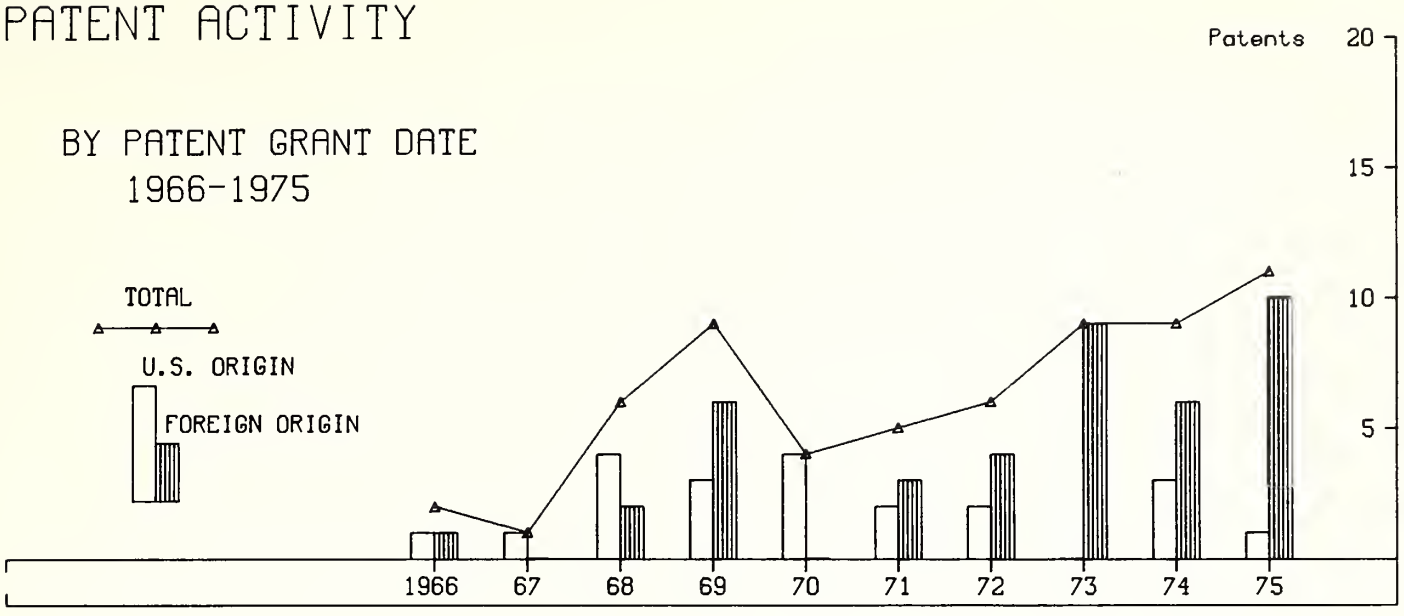
3,882,516 (Ogiso et al, Canon Kabushiki Kaisha) - Discloses a camera with electric motor film advance employing a rotational speed detector which senses completion of film wind-up to deactivate the film drive mechanism.

3,893,136 (Ando et al, Fuji Photo Optical Co., Ltd.) - Discloses a camera having electronic control for motor film advance, shutter setting and exposure time. Upon activation of a shutter button, a one-shot multivibrator provides a pulse to a circuit to control exposure time of a solenoid activated shutter. At the trailing edge of the pulse a motor is activated to set the shutter and advance the film.

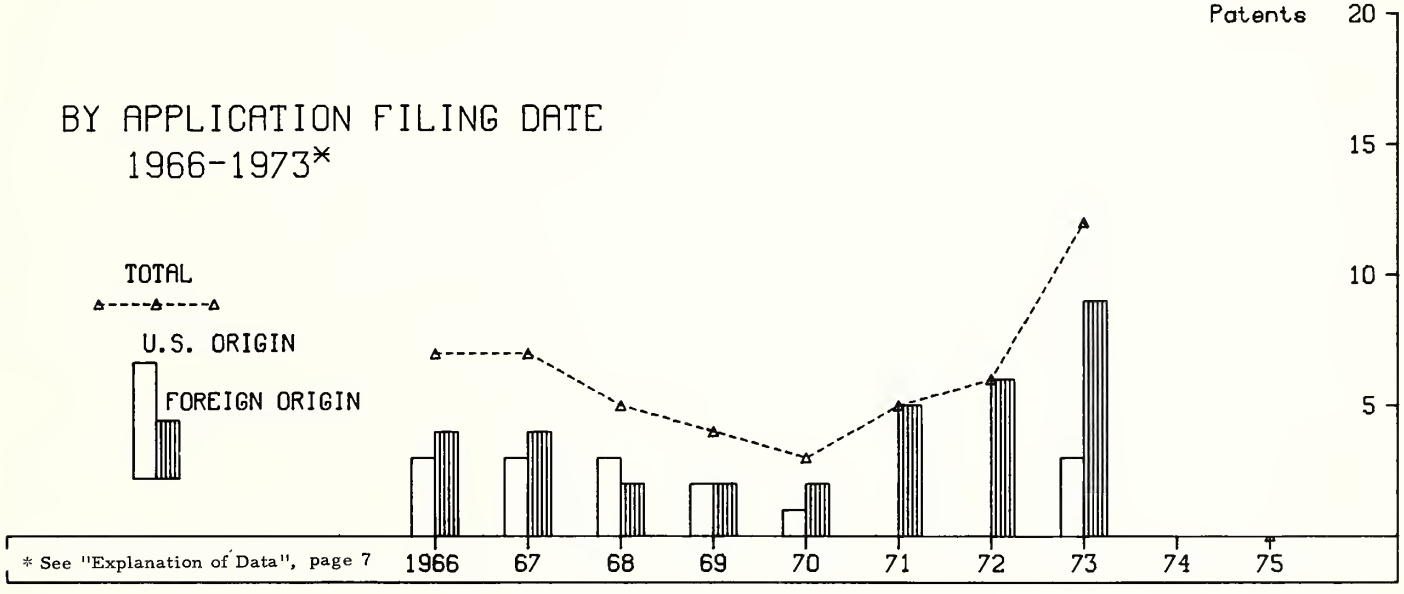
3,898,679 (Ogiso et al, Canon Kabushiki Kaisha) - A camera employs two electric motors for performing film wind-up, shutter setting and shutter release. Pressing the shutter release button activates the first motor for shutter release. Release of this button activates the second motor to wind the film and set the shutter.

PATENT ACTIVITY

BY PATENT GRANT DATE
1966-1975



BY APPLICATION FILING DATE
1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	2	1	6	9	4	5	6	9	9	11	62	7	7	5	4	3	5	6	12	49
UNITED STATES	1	1	4	3	4	2	2		3	1	21	3	3	3	2	1			3	15
TOTAL FOREIGN	1		2	6		3	4	9	6	10	41	4	4	2	2	2	5	6	9	34
JAPAN				5		2	4	8	6	9	34	2	3	2	2	1	4	6	8	28
GERMANY			1	1		1				1	4	1	1			1			1	4
SWEDEN								1			1						1			1
NETHERLANDS			1								1	1								1
UNITED KINGDOM	1										1									

PHOTOELECTRICALLY CONTROLLED CAMERAS

Cameras containing photoresistive or photovoltaic light sensing devices which determine the intensity or quantity of light emanating from a particular location or direction. In response to such light, these devices change their resistance or generate an electric signal which is used to control various camera functions such as focus, shutter speed, diaphragm opening and flash timing. Cameras found here may contain plural photoelectric sensors as well as indicators to show the user the state of each function under control. (Class 354, subclasses 23-61)

Average Annual Activity Indices (1973-75)

Growth	9.1%	Corporate Owned	94.2%
Foreign Share	80.6%	Government Owned	0.2%

Recent Activity

Recent developments are directed toward providing smaller and cheaper cameras; cameras which use modern circuit techniques for accuracy of control; and, cameras having programming devices for automatic operation. Patents, issued since August 1974, include:

3,852,776 (Nobusawa, Asahi Kogsku Kogyo Kabushiki Kaisha) - Discloses a camera having a shutter mechanism for exposure time control consisting of two tandem-connected timing circuits response to a photocell. The first circuit is controlled by the amount of light sensed. It uses a storage capacitor and Schmitt trigger, to control the opening of the front curtain of the shutter after a first time interval. The second circuit uses similar components to close the rear curtain of the shutter at the end of a second time interval.

3,882,511 (Tsujimoto et al, Minolta Camera Kabushiki Kaisha) - A camera which uses either programmed exposure control or shutter-speed-precedence exposure control by operation of a selecting member. For programmed control, a resistor in a timing circuit determines shutter speed in response to the amount of deflection of an ammeter pointer in a photoelectric light meter. The amount of deflection also controls aperture size. For shutter-speed-precedence control, a manually operated shutter speed dial selects a timing circuit resistor while the ammeter pointer deflection controls aperture size.

3,896,456 (Toyoda, Nippon Kogaku Kubushiki Kaisha) - Discloses a camera containing an electronic shutter control device. A storage capacitor across the inputs of a differential amplifier is used to store the difference between a preset voltage, representing an exposure factor, and a photocell derived voltage. This difference controls the film exposure. The storage capacitor allows accurate control because it minimizes current leakage and is not affected by temperature and power supply variations.

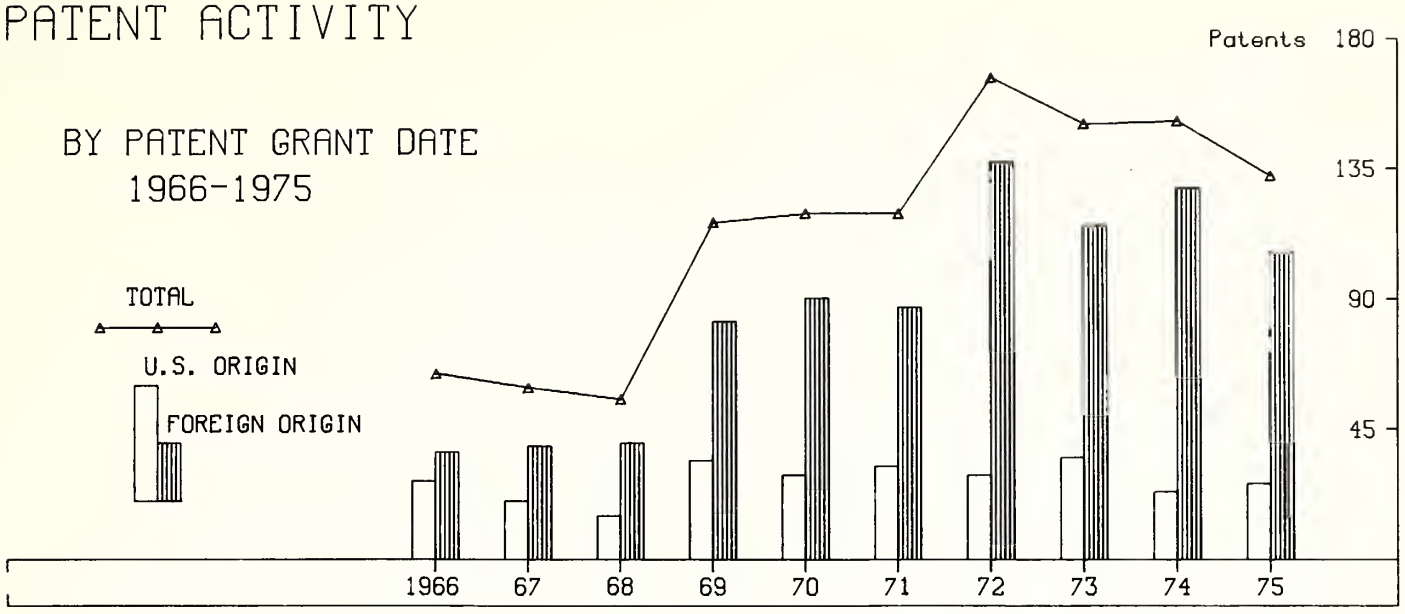
3,898,676 (Machida et al, Canon Kabushiki Kaisha) - Discloses a camera having an automatic focusing device which employs two groups of photoelectric elements. Each group provides respective output voltages to an electric scanning device to obtain a pair of signals. Each signal, which corresponds to a time series of outputs from the elements of a group, is applied to a sample-hold circuit, filtered, and applied to a phase discriminator. The discriminator output controls a servomotor to adjust an objective lens system for proper focusing.

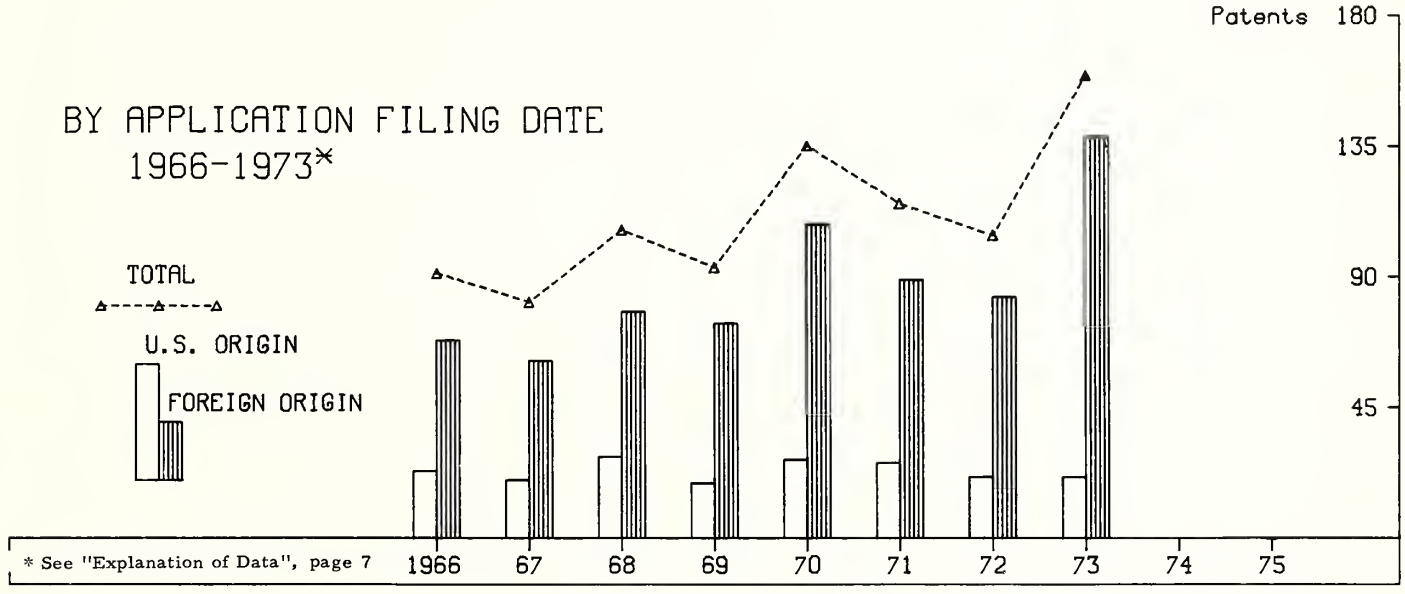
3,903,529 (Sorimachi et al, Canon Kabushiki Kaisha) - Discloses a camera having an exposure control device which regulates aperture size and exposure time. Aperture size is determined by a capacitor employed in a time constant circuit which charges to a predetermined voltage level upon activation of a shutter release button. A switch then opens the shutter and connects the charged capacitor into another time constant circuit. This second time constant circuit contains a photoresistive element responsive to incoming light, which, in conjunction with discharge of the capacitor, closes the shutter.

3,921,186 (Lermann, AGFA-Gevaert AG) - Discloses a camera diaphragm control device which uses a magnetic force to control the diaphragm opening. When a preset light level is reached, a photoelectric device energizes an electromagnet. This, in turn, engages a device that mechanically prevents further diaphragm opening.

3,922,692 (Yata et al, Minolta Camera Kabushiki Kaisha) - Discloses a camera with an exposure time control circuit having a capacitor, charged at commencement of the exposure interval, and a switching circuit for terminating exposure at a predetermined level of capacitor voltage. Received light undergoes a logarithmic conversion to a voltage which is stored. A transistor applies an antilogarithmic conversion to the stored voltage to provide charging current linearly related to received light. Errors in exposure time are reduced to a minimum by timed operation of switches within the control circuit.

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	64	59	55	116	119	119	166	150	151	132	1131	91	81	106	93	135	115	104	159	884
UNITED STATES	27	20	15	34	29	32	29	35	23	26	270	23	20	28	19	27	26	21	21	185
TOTAL FOREIGN	37	39	40	82	90	87	137	115	128	106	861	68	61	78	74	108	89	83	138	699
JAPAN	7	11	6	33	32	48	99	92	100	91	519	20	24	34	54	80	65	65	116	458
GERMANY	29	27	33	46	55	37	35	14	25	12	313	45	35	42	18	25	17	13	20	215
FRANCE					1	1	1			1	4		1	1	1				1	4
SWITZERLAND		1		2	1		1	1			6	1	1	1		1	1			5
AUSTRIA			1			1		1		1	4				1			1	1	3
NETHERLANDS	1				1			1	1		4					2	3			5
UNITED KINGDOM							1	4			5					2	3			5
SWEDEN								2	1		3						1	2		3
ISRAEL				1					1		2	1					1			2
ALL OTHER (2)										1	1							1		1

MULTIPLE COMPONENT LENSES

Combinations of more than four lens components arranged in series with their optical centers in alignment on the optical axis of the lens. The planes of the lens components are perpendicular to the axis; and the lens components at each end of the axis are so spaced along the axis that parallel light rays entering one end, pass through all lens components and are refracted to a focus no more than once. A lens component may be convergent or divergent, and is either a single transparent mass of refractive material or a group of such masses arranged in series, with adjacent surfaces either in full contact or nearly in contact. These multiple component lenses are used in cameras (photographic and TV), microscopes, telescopes and copying machines. (Class 350, subclasses 214 through 219)

Average Annual Activity Indices (1973-75)

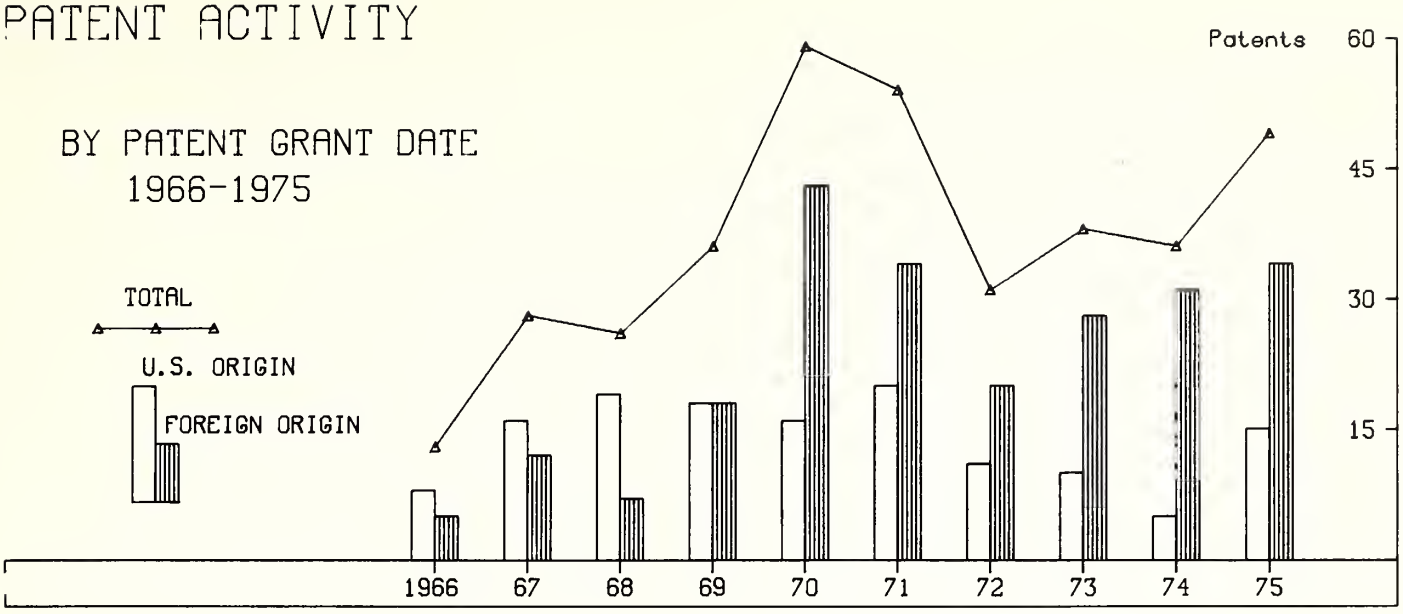
Growth	6.7%	Corporate Owned	95.1%
Foreign Share	75.6%	Government Owned	0.8%

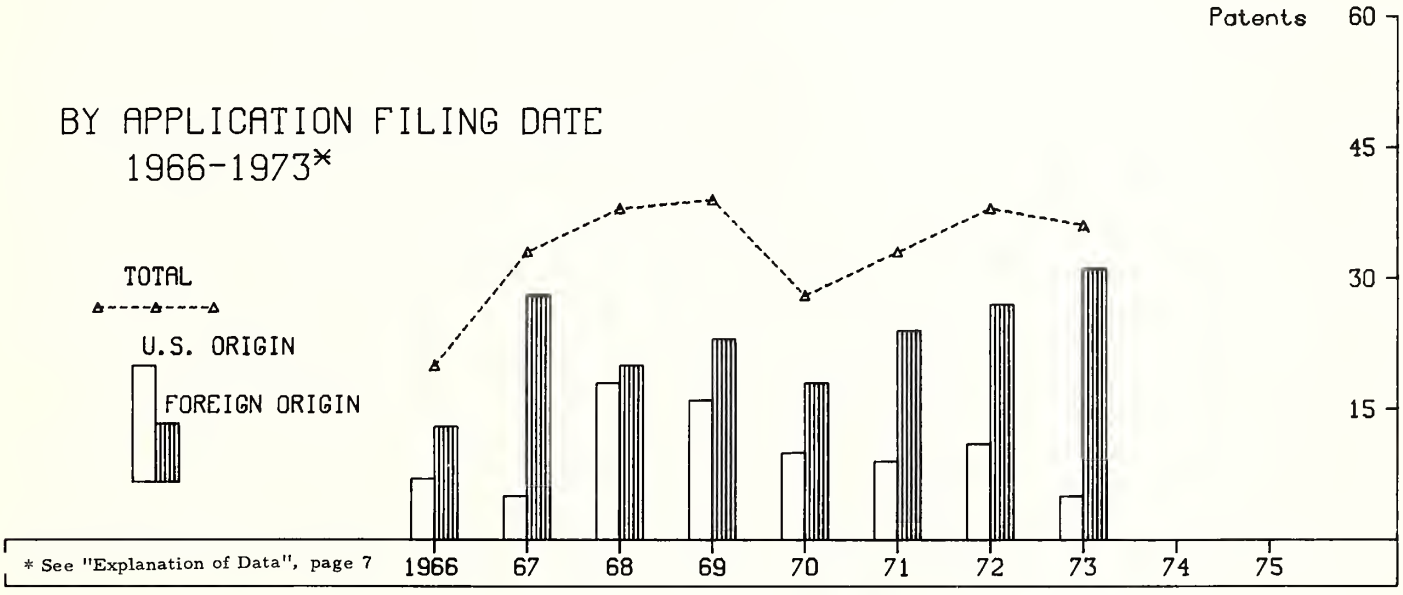
Recent Activity

Basic parameters for multiple component lenses are: number of lens components; angle of coverage; and F number (F/, the ratio of lens diameter to its focal distance). Wide angle lenses, allowing one to photograph a large area, with low F/, for shorter exposure times, are the usual goals. Patents, issued since June 1974, include:

PATENT NO.	INVENTOR	ASSIGNEE	ANGLE	# LENSES	F/
3,815,974	Momiyama	Canon Kabushiki Kaisha	46°	7	1.8
3,817,602	Kazamaki	Asahi Kogaku Kogyo Kabushiki Kaisha	24°	10	1.4
3,817,603	Takahashi	Asahi Kogaku Kogyo Kabushiki Kaisha	45.4°	6	1.7
3,825,321	Takahashi	Asahi Kogaku Kogyo Kabushiki Kaisha	80°	10	8.0
3,830,559	Matsubara	Olympus Optical Co., Ltd.	84°	10	2.0
3,832,037	Nakagawa	Olympus Optical Co., Ltd.	86°-92°	8	2.8-3.5
3,841,640	Takahashi et al	Asahi Kogaku Kogyo Kabushiki Kaisha	102°	11	3.5
3,850,509	Nakagawa	Olympus Optical Co., Ltd.	180°	11	3.5
3,851,953	Nakagawa	Olympus Optical Co., Ltd.	46°	7	1.4
3,854,797	Yokota	Canon Kabushiki Kaisha	2.44°-6.2°	6-9	5.6-6.0
3,856,385	Takahashi	Asahi Kogaku Kogyo Kabushik Kaisha	75°	8	2.8
3,856,386	Fujioka	Kabushiki Kaisha Yashica	94.5°	11-12	3.3
3,862,794	Fujii	Olympus Optical Co., Ltd.	76°	7	2.0
3,864,026	Glatzel	Carl Zeiss Stiftung	85°-110°	10-13	3.8-2.8
3,864,027	Harada	Olympus Optical Co., Ltd.	6°11'	5	6.3
3,865,471	McCrobie	Xerox Corp.	24°	8	3.2
3,868,173	Miles et al	Maris Ambats et al	40°	5	1.5
3,868 174	Yakota	Canon Kabushiki Kaisha	8.24°	5	2.8
3,870,400	Yamashita et al	Olympus Optical Co., Ltd.	63° 102°	10 13	2.0 3.5
3,871,749	Harada	Olympus Optical Co., Ltd.	45°	6	4.46
3,874,770	Shimizu	Nippon Kogaku K.K.	62°-74.4°	6-7	2.0-2.8
3,877,795	Yamashita	Olympus Optical Co., Ltd.	100°	12	3.5
3,887,269	Nakagawa	Olympus Optical Co., Ltd.	2°40'	5	11.0
3,915,558	Glatzel	Carl Zeiss Stiftung	60°+	8	1.8-1.2
3,923,369	Nakamura	Minolta Camera Kabushiki Kaisha	72°	10	2.0
3,926,506	Maeda	Olympus Optical Co., Ltd.	78°28'	7	4.0

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	13	28	26	36	59	54	31	38	36	49	370	20	33	38	39	28	33	38	36	265
UNITED STATES	8	16	19	18	16	20	11	10	5	15	138	7	5	18	16	10	9	11	5	81
TOTAL FOREIGN	5	12	7	18	43	34	20	28	31	34	232	13	28	20	23	18	24	27	31	184
JAPAN	1		2	6	27	13	10	22	24	26	131	5	14	12	10	10	16	21	25	113
GERMANY	2	7	4	9	10	11	6	4	3	6	62	6	8	5	9	3	4	4	4	43
SWITZERLAND		1	1	1	2	4	3				12		4		1	2	2			9
UNITED KINGDOM	1	1		1		4		1			8	1		1	2		1			5
FRANCE		1		1	4				1		7	1	2	2					1	6
NETHERLANDS		2							2		4							2		2
AUSTRIA							1	1	1	1	4					2	1		1	4
CANADA	1					1				1	3						1			1
CZECHOSLOVAKIA						1					1				1					1

PHOTOTHERMIC COMPOSITIONS

Light-sensitive compositions (and their preparation) containing a light sensitive silver compound (e.g. silver halide. The compositions upon exposure to light, produce an invisible latent image developable by heat alone. (Class 96, subclass 114.1)

Average Annual Activity Indices (1973-75)

Growth	28.0%	Corporate Owned	98.5%
Foreign Share	32.3%	Government Owned	0.0%

Recent Activity

Recent patents focus on heat-developable light-sensitive materials made up of support film (e.g. cellulose acetate) carrying an organic silver salt relatively stable to light (e.g. silver laurate, silver behenate, or silver saccharide) that provides the image; a catalytic amount of a light sensitive silver halide in very fine grain emulsion; a reducing agent (e.g. hydroquinone) for the organic silver salt in the presence of the silver halide, and a transparent polymeric binder (e.g. gelatin). Patent activity since March 1974 includes:

3,798,039 (Leclair, Nashua) - Discloses a reactive organic peroxide/silver soap mixture which enhances the color contrast between a photographic image and its background.

3,802,888 (Willits, Minnesota Mining) - Discloses photographic sheets which may be manufactured, packed and handled while exposed to light and then made light-sensitive by simple heating. Mercuric bromide is incorporated into the photographic sheet. When heat is applied, the bromide ion reacts with organic silver salt to give photosensitive silver bromide in full catalytic proximity to the remaining organic silver salt.

3,819,382 (von Konig et al, AGFA-Gevaert) - Hydroxy chromans and coumaranes are reducing agents with improved storage stability for light-sensitive photographic materials susceptible to thermal development.

3,827,889 (Ohkubo et al, Fuji) - Light-sensitive compositions for thermal development containing reducing agents, such as, ascorbic acid and its mono- or di-esters, dihydroxyacetone, furoin or benzoin, which can be decomposed by ultra-violet irradiation.

3,832,186 (Masuda, Fuji) - Addition of 1,2,4-triazole derivatives to heat developing photosensitive materials yields a black image after development.

3,839,048 (Poot et al, AGFA-Gevaert) - Discloses use of 1,4-dihydropyridine derivatives as auxiliary reducing agents for silver soap which improves the color density of silver metal images.

3,844,797 (Willems et al, AGFA-Gevaert) - Phthalazinone derivatives are used as toning agents in dry heat photography to shift the silver image tone from yellow-brown to black and blue-black.

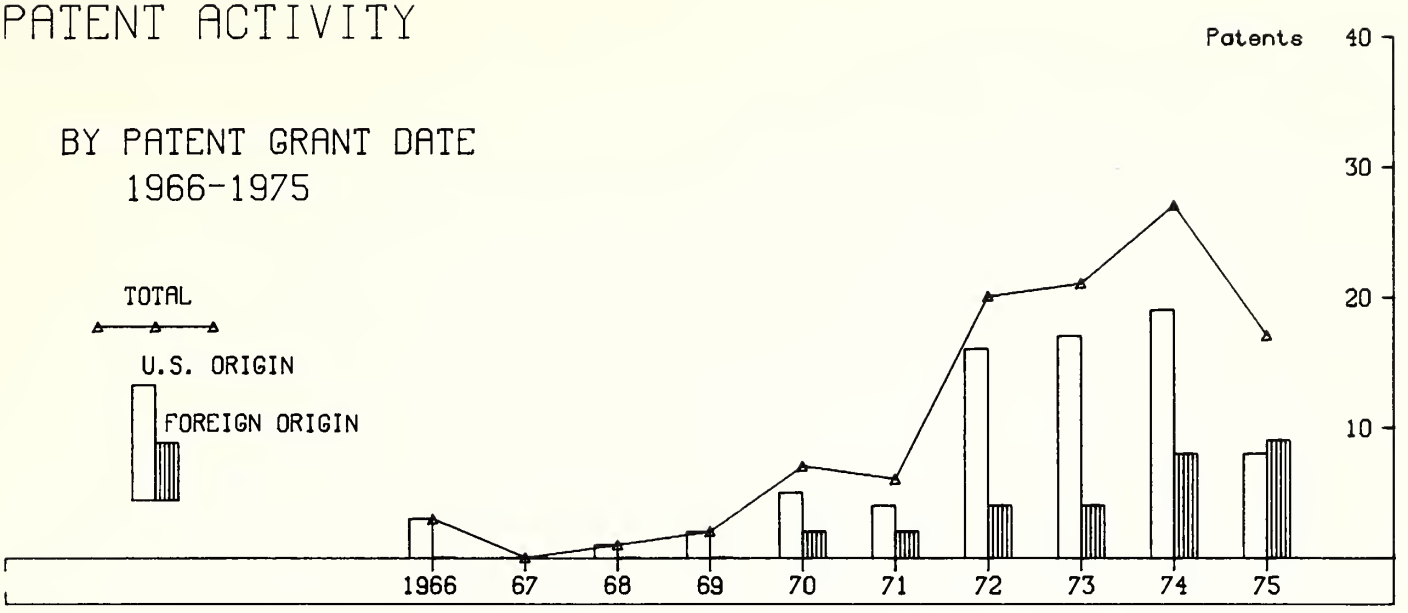
3,870,523 (Ikenoue et al, Fuji) - An aromatic diazocompound sensitizer is added to a heat developable photosensitive layer.

3,887,378 (Klein et al, AGFA-Gevaert) - The silver salts in the light-struck areas of a photographic layer are reduced by hydroxyindanes.

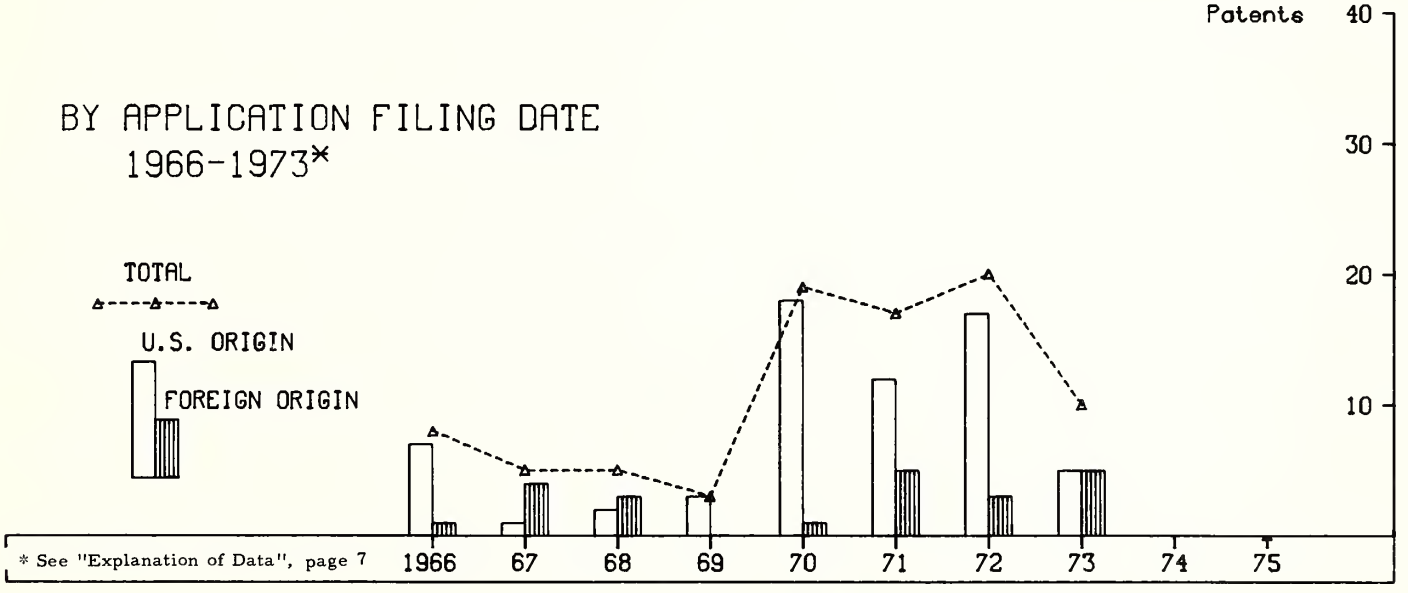
3,933,508 (Ohkubo et al, Fuji) - Discloses polymers such as gelatin and polyvinyl alcohol useful as the overcoat layer for heat developable light-sensitive materials. These polymers are heat resistant, colorless, and soluble in solvents.

PATENT ACTIVITY

BY PATENT GRANT DATE 1966-1975



BY APPLICATION FILING DATE 1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	3		1	2	7	6	20	21	27	17	104	8	5	5	3	19	17	20	10	87
UNITED STATES	3		1	2	5	4	16	17	19	8	75	7	1	2	3	18	12	17	5	65
TOTAL FOREIGN					2	2	4	4	8	9	29	1	4	3		1	5	3	5	22
JAPAN					1	1	2	1	3	7	15	1	2	1			1		4	9
BELGIUM							2	2	3	1	8		1	1			3	2	1	8
UNITED KINGDOM					1			1	1		3		1			1		1		3
GERMANY						1			1	1	3			1			1			2

AZOLE DERIVATIVES

Organic compounds (and their preparation) having a para-nitrogen-benzene-sulfoxy-X (X= c or N) moiety and an azole moiety (5 membered heterocyclic ring containing two hetero-atoms at least one of which is nitrogen). Included are sulfa ($H_2NC_6H_5SO_2NH$-) containing compounds having a selenazone, oxazole or pyrazole ring, generally useful as pharmaceuticals. Other compounds found here are useful as optical brighteners or dyes. (Class 260, subclass 239.9).

Average Annual Activity Indices (1973-75)

Growth	5.5%	Corporate Owned	86.4%
Foreign Share	77.3%	Government Owned	0.0%

Recent Activity

Recent activity focuses on the development of various new compounds useful as optical brightening agents for textiles, pharmaceuticals, and antihalation dyes in photography. Patents, issued since May 1972, include:

3,665,002 (Popelak et al, Boehringer) - Discloses 5-phenyl-tetrazole derivatives which have diuretic and saluretic applications in pharmacology.

3,753,978 (Adelsberger et al Badische Anilin) - Discloses diphenyl pyrazoline derivatives, containing a 5-carboxylic ester or amide group, which are useful as optical brighteners for natural and synthetic textile fibers.

3,755,306 (Treuner, Squibb) - 3-Aryl-1,2,4-oxadiazoles which are useful as anti-microbial agents, hypoglemic agents, and antiinflammatory agents.

3,767,643 (Kunstmannn et al, Hoechst) - Discloses 5-(aminobenzenesulfonylamino)-benzimidazolones which can be diazotized, and coupled with N-acetoacetylamino compounds of the benzene-, diphenyl-, and benzimidazolone series to give diazo dyes having brilliant shades and excellent fastness properties.

3,835,126 (Mergler et al Hoechst) - Discloses 1,5-diaryl-3-styryl pyrazolines which are useful as optical brighteners for textile fibers, expecially, when mixed with 1, 3-diaryl pyrazoline brighteners.

3,836,522 (Somlo et al, Ciba-Geigy) - 1,3-Diphenyl-4-methyl-5-alkyl pyrazolines which are optical brighteners with a neutral white shade for textile fibers, detergents, and soaps.

3,852,275 (Domergue et al, Kuhlmann) - Aromatic pyrazoline sulphonium derivatives which are wash fast optical brighteners for whitening polyacrylonitrile fibers.

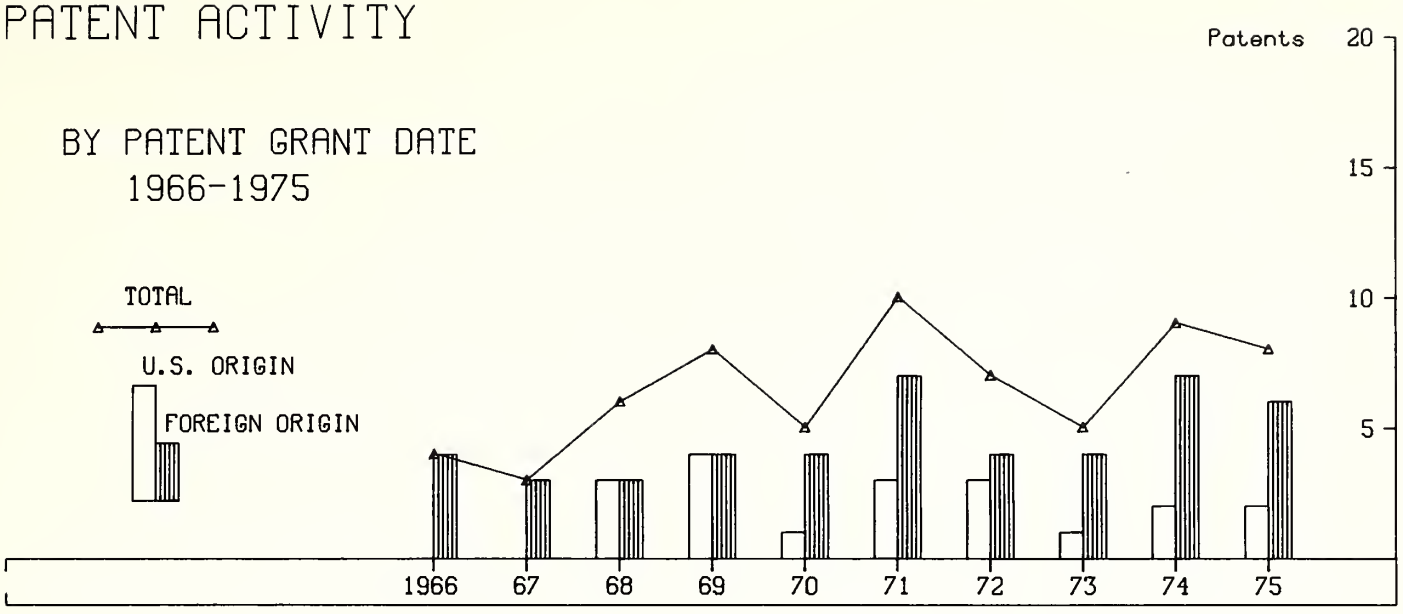
3,865,816 (Mengler, Hoechst) - Aromatic pyrazoline sulfonamide or sulfonic acid derivatives which are optical brighteners giving brilliant whiteness and good light fastness on textile fibers.

3,933,798 (Curtis et al, Polaroid) - Water-insoluble bis-pyrazolone oxonol dyes having alkyl sulfonamido-phenyl ($RNHSO_2C_6H_4$-) groups on the 1-position nitrogens and electron-withdrawing substituents (e.g. $ROCH_2CH_2OCO$-) on the 3-position carbons. These are antihalation dyes for absorbing scattered light in photography.

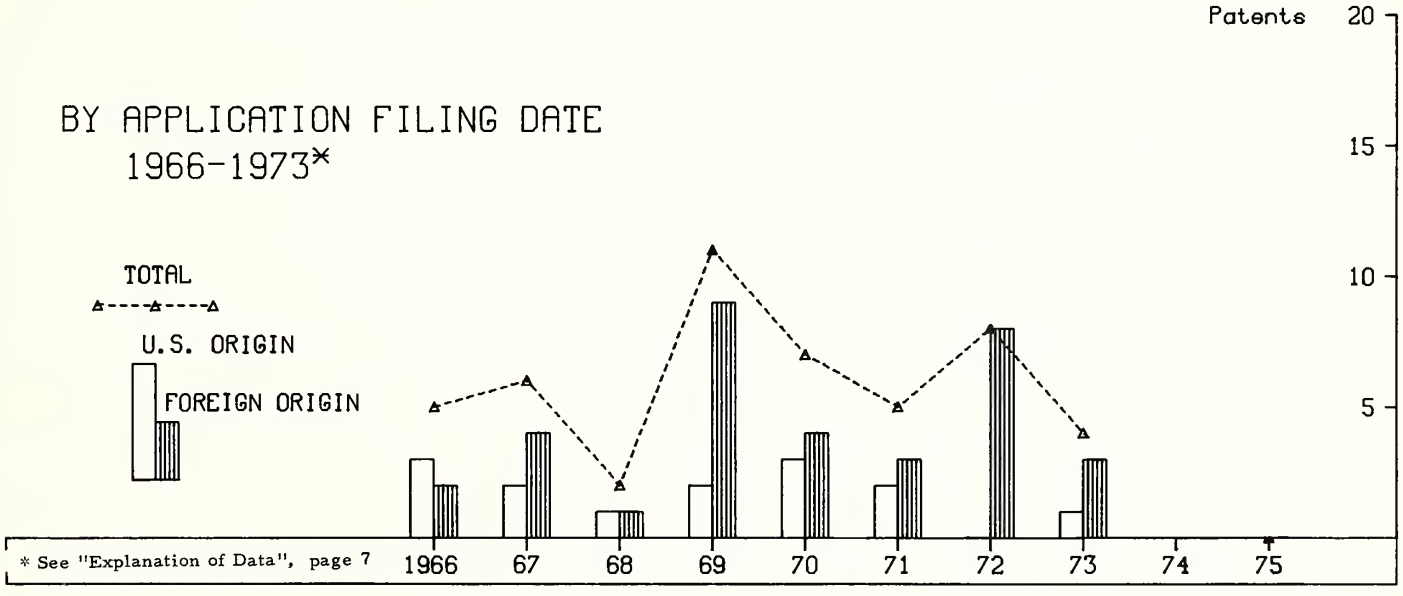
3,939,154 (Bolton et al, Sandoz) - Aromatic pyrazolines derivatives are optical brightening agents for natural and synthetic polyamide fibers.

PATENT ACTIVITY

BY PATENT GRANT DATE 1966-1975



BY APPLICATION FILING DATE 1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	4	3	6	8	5	10	7	5	9	8	65	5	6	2	11	7	5	8	4	48
UNITED STATES			3	4	1	3	3	1	2	2	19	3	2	1	2	3	2		1	14
TOTAL FOREIGN	4	3	3	4	4	7	4	4	7	6	46	2	4	1	9	4	3	8	3	34
GERMANY	1		2	1	2	5	1	3	1	3	19	1	2		5	1	1	4	1	15
SWITZERLAND		2	1	1	1	2	2		4		13	1		1	3	2		3		10
JAPAN	1	1		2	1		1				6		2		1					3
FRANCE								1	1		2					1	1			2
SWEDEN	1										1									
AUSTRIA	1										1									
HAITI									1		1						1			1
DENMARK										1	1								1	1
CANADA										1	1								1	1
ISRAEL										1	1							1		1

PYRAZOLINES AND PYRAZOLIDINES

Compounds (and their preparation) containing a five membered ring that is partially or fully hydrogenated, and two hetero-nitrogen atoms in the 1- and 2- positions (e.g. 2-pyrazoline). (Class 260, subclass 310D)

Average Annual Activity Indices (1973-75)

Growth	7.1%	Corporate Owned	93.9%
Foreign Share	72.7%	Government Owned	0.0%

Recent Activity

Recent activity focuses on compounds useful as pharmaceuticals, intermediates, optical whiteners, and light sensitive agents in photography. Patents, issued since April 1973, include:

3,729,464 (Olechowski, Cities Service) - Cyanopyrazolyl alkanes are oxidized to cyanocyclopropyl alkanes. These can be cleaved by catalytic hydrogenation to give aliphatic amines useful in the manufacture of polyamide resins.

3,755,352 (Rosenberger et al, Ciba-Geigy) - A novel aryl pyrazoline sulphonic acid ester is an optical whitening agent for cellulose acetate fibers, intended to impart a strong and brilliant white, free of undesirable green or green-blue hues.

3,780,058 (Brzozowski et al, Poland) - 2 - Pyrazoline- 1 - carboxamide sulphonamide derivatives which have hypoglycemic activity, useful for the reduction of the glucose level in the blood.

3,859,303 (Katsuyama et al, Fuji Photo) - Spiro-pyrazoline derivatives are disclosed. They can be used as organic photoconductive materials for electrophotography, as organic fluorescent materials, and as additives for silver or non-silver photographic materials.

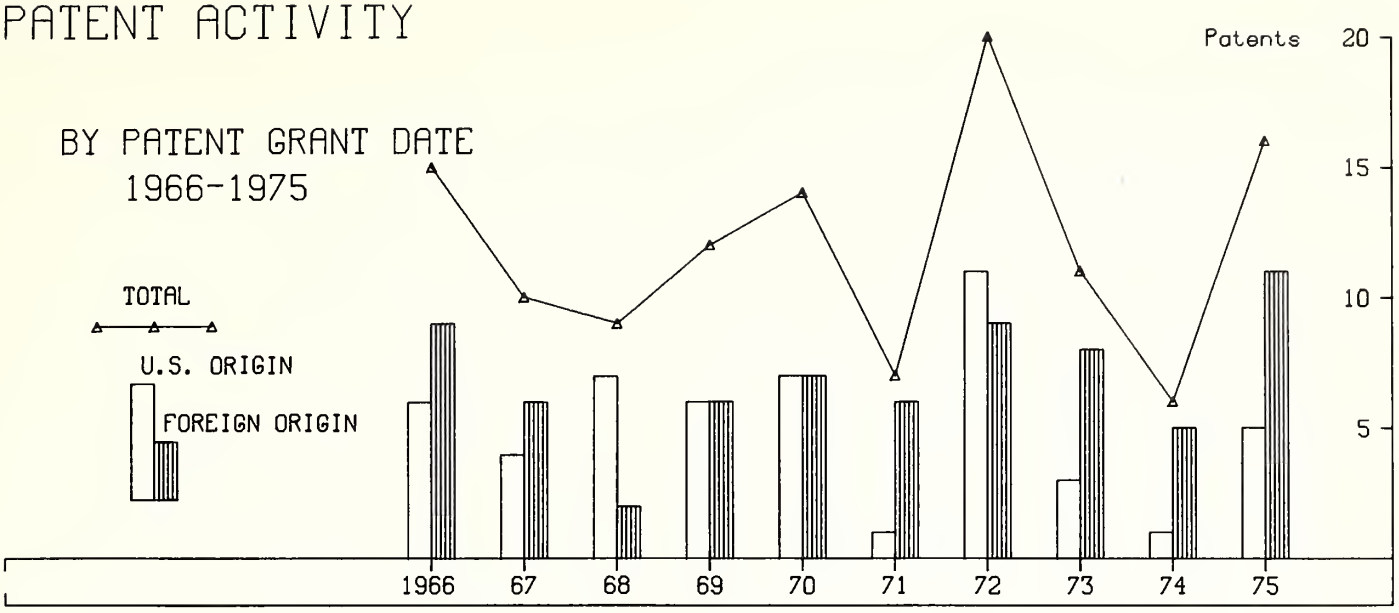
3,883,549 (Pearson, Minnesota Mining) - Aryl-3, 3'-pyrazolyl-2 - pyrazoline compounds which fluoresce strongly under ultra-violet light and are useful as optical whitening agents and fluorescent pigments.

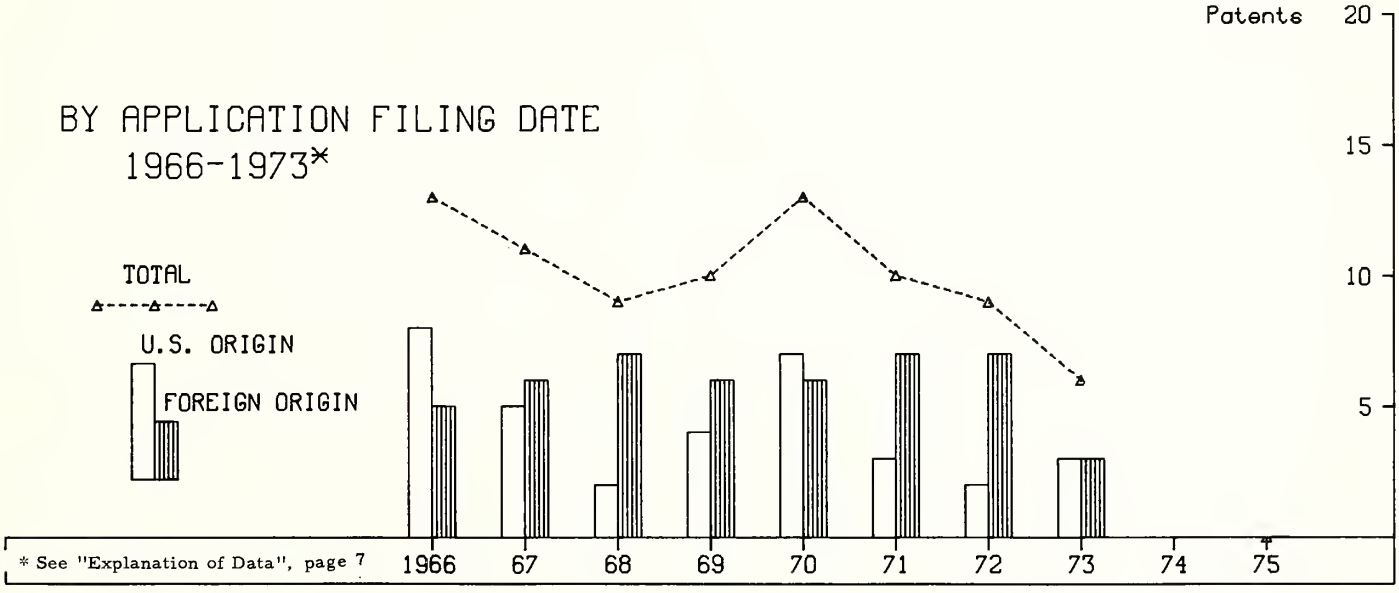
3,896,143 (Kathamala, Sandoz) - Substituted pyrazolyl phenylacetic acid derivatives prepared from cinnamoyl phenylacetic acid derivatives and substituted hydrazines, useful as anti-inflammatory agents for the treatment of arthritis.

3,927,025 (Korbonits et al, Hungary) - Discloses the preparation of substituted 3-amino- Δ^2- pyrazoline derivatives, useful in photography and as pharmaceutical antispasmodics.

3,929,826 and 3,828,069 (Stagi, Ciba-Geigy) - 1, 3-diaryl-3a, 4, 5, 6, 7, 7a- hexahydroindazole compounds useful as optical whiteners which are white in color, and color compatible with synthetic fibers, detergents and soaps.

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	15	10	9	12	14	7	20	11	6	16	120	13	11	9	10	13	10	9	6	81
UNITED STATES	6	4	7	6	7	1	11	3	1	5	51	8	5	2	4	7	3	2	3	34
TOTAL FOREIGN	9	6	2	6	7	6	9	8	5	11	69	5	6	7	6	6	7	7	3	47
SWITZERLAND	2	1	1	2	3		3	2	2	2	18	4	3		1	1	1	2	1	13
JAPAN	2	4		2		2	1	1	1	1	14		2	2	1		1	1		7
GERMANY	1				1	4	2	3	1	1	13		1		3	4	2	1		11
UNITED KINGDOM	1							1		5	7					1	1	1	2	5
FRANCE	1						2			1	4			2			1			3
CANADA				1	3						4	1		3						4
BELGIUM				1			1				2				1					1
ISRAEL		1	1								2									
AUSTRIA	1										1									
ALL OTHER (4)	1							1			2						1	2		3

POLYPYRIDYLS

Compounds (and their preparation) containing two or more pyridyl moieties (C_5H_4N) and no fused benzene ring. Typical of the compounds found here are 2, 2' - and 4, 4'-bipyridyls. 1,1'-dimethyl-4,4'-bipyridylium dibromide is useful as a herbicide, and 4,4'-Bipyridinium ("viologen") compounds, which undergo a reversible change in spectral absorption in going from the oxidized to reduced state, are useful as photochemical and redox indicators. (Class 260, subclass 296D)

Average Annual Activity Indices (1973-75)

Growth	15.1%	Corporate Owned	91.8%
Foreign Share	79.6%	Government Owned	2.0%

Recent Activity

Recent activity focuses on chlorinated bipyridines useful as herbicides, insecticides, fungicides, bactericides, plastic ultraviolet light stabilizers, and intermediates in the synthesis of dyes and sulphonamide-type pharmaceuticals. Patents, issued since January 1974, include:

3,787,426 (Colchester et al, ICI) - An N-hydroxyalkyl pyridinium salt is reacted with sodium cyanide and then oxidized to 1,1'-dihydroxyalkyl - 4,4'-bipyridylium salt, a herbicide.

3,787,427 (Potter, ICI) - A pyridine compound is heated (150-400°C) in the presence of oxygen and halogen to give 4,4'-and 2,2'-bipyridyls.

3,787,428 (Anders et al, Du Pont) - Discloses aromatic-substituted 5,5'-bipyridyls which are ultraviolet light absorbers with high inherent photostability. These are added to plastic materials to prevent degradation due to sunlight.

3,804,845 (Moore, ICI) - A 4-or2-halopyridine is reacted with an alcohol under basic conditions over a palladium catalyst at 50-80° C to produce 4,4'-or 2,2'-bipyridyls.

3,819,558 (Ruetman, Dow) - 2,2' - or 4,4'-Bipyridines are partially ring chlorinated (1-4 chlorine atoms) by treating a vaporized mixture of bipyridine with excess chlorine at 200 - 400°C.

3,822,279 (Joy et al, ICI) - 2,2' -Bipyridyls are prepared by percolating liquid pyridine (or alkyl pyridine) through a bed of hot (110°C) Raney nickel catalyst (nickel/aluminum).

3,838,157 and 3,873,555 (Bowden, ICI) - 2-(Pyridyl) - tetrahydropyran vapor is oxidized by oxygen gas in the presence of ammonia over a dehydrogenation catalyst (alumina, silica, chromia) at 380°C to produce 4,4'-bipyridyl compounds.

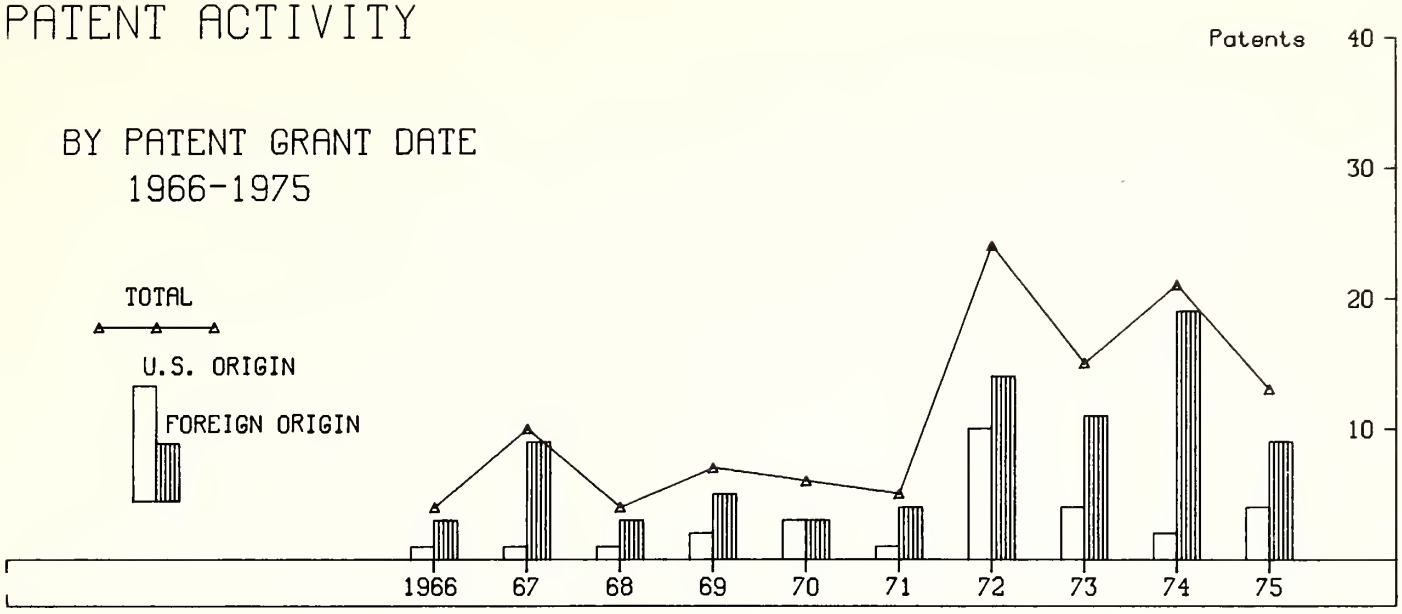
3,882,133 (Dalton, ICI) - Pyridine or an alkyl pyridine (e.g., α, β, or γ -picoline) is heated (320-350° C) with its corresponding pyridine salt (e.g., pyridine hydrochloride) or its quaternary pyridinium salt to give 2,2'-bipyridyls.

3,923,821 (Moore, Polaroid) - Discloses 4,4'-bipyridinium ("viologen") salts which are suitable monomers for interfacial polycondensation to film-forming "polyviologens". They are also useful as redox indicators in variable light-filtering devices.

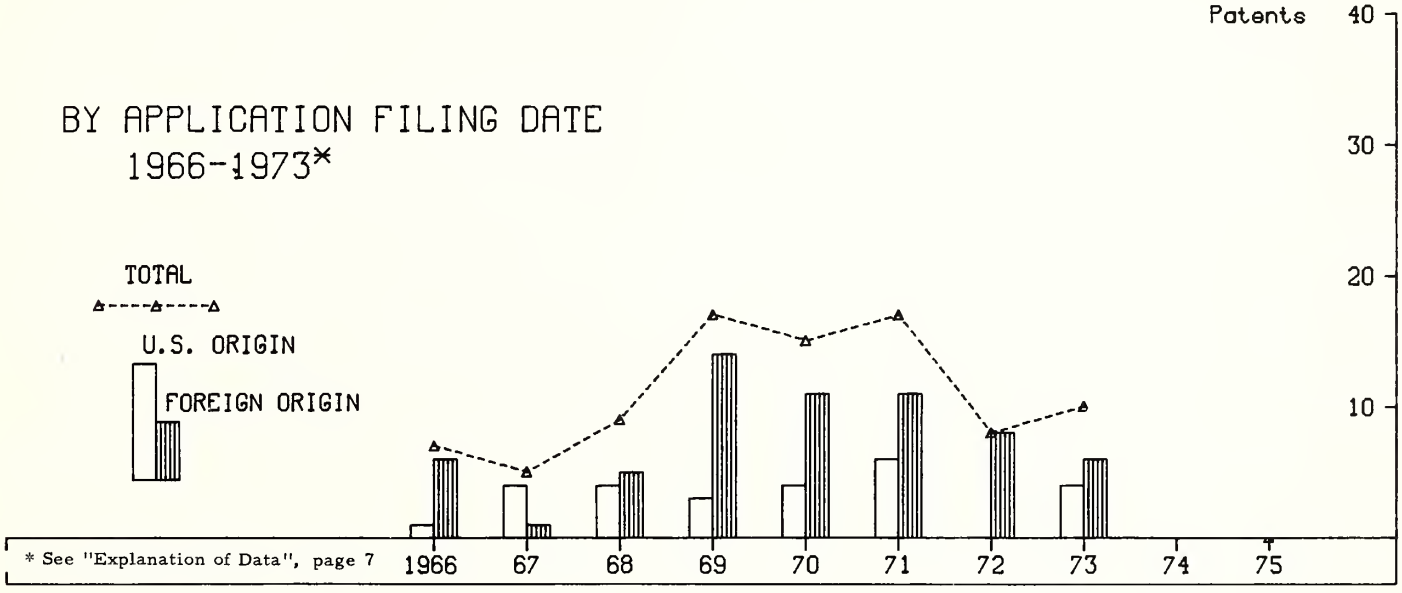
3,927,009 (Potter, ICI) - Discloses a process to produce 4,4'-and 2,2'-bipyridyls by heating (180 - 300°C) a pyridine with 1-(4-pyridyl)- pyridinium halide.

PATENT ACTIVITY

BY PATENT GRANT DATE 1966-1975



BY APPLICATION FILING DATE 1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	4	10	4	7	6	5	24	15	21	13	109	7	5	9	17	15	17	8	10	88
UNITED STATES	1	1	1	2	3	1	10	4	2	4	29	1	4	4	3	4	6		4	26
TOTAL FOREIGN	3	9	3	5	3	4	14	11	19	9	80	6	1	5	14	11	11	8	6	62
UNITED KINGDOM	3	9	3	4	3	4	12	8	10	9	65	5	1	3	13	10	7	5	3	47
FRANCE							1		5		6				1	1		1	3	6
GERMANY							1	2	1		4			2			1	1		4
SWITZERLAND				1				1			2	1					1			2
ITALY									2		2					1	1			2
SWEDEN									1		1						1			1

PLANT GROWTH RETARDERS

Compositions and associated processes for inhibiting normal growth of plants. This includes reducing plant height, stimulating seed germination, inducing flowering, and promoting production of seedless fruits. In certain plants, growth retardation may result in smaller, bushier plants having increased resistance to drought and temperature extremes, and which can be more easily cultivated and harvested. These chemicals are particularly useful for slowing down turf grass growth to reduce mowing frequency, and for reducing lodging in cereals. (Class 71, subclass 76).

Average Annual Activity Indices 1973-75

Growth	25.4%	Corporate Owned	94.7%
Foreign Share	30.9%	Government Owned	0.0%

Recent Activity

Recent patent activity focuses on compositions and methods that: 1) control turf grass growth with minimal toxic side effects; 2) reduce lodging in cereal grains, 3) stunt sugar cane growth to increase sugar concentrations in these plants. Patents, issued since November 1974, include:

3,849,116 (Swidler et al, Stanford Research) - Discloses compositions containing precursors of organic borate esters which are effective plant dwarfing agents at low concentrations.

3,850,608 (Hamm, Monsanto) - Discloses phosphono-methylimino acetic acid containing compositions useful for retarding the growth of turf grasses, and reducing seed head formation and seedhead stalk elongation.

3,852,056 (Draber et al, Bayer) - Discloses a heterocyclic-substituted N-benzylimidazole composition which inhibits plant growth.

3,853,531 (Ratts, Monsanto) - Discloses application of 2-Chloro-acetanilides plant growth regulators to plant to shorten main stems and increase lateral branching. The smaller, bushier plants produced demonstrate increased resistance to drought, temperature extremes, lodging, and pest infestation.

3,856,501 (Zech et al, Badische) - Discloses a method of stunting plant growth using cyclic sulfonium compositions (e.g. 1methyl-1-thia-cyclo-hexanium bromide).

3,856,570 (George et al, ICI) - Discloses use of the ethyl ester of 5-(4-chlorophenyl) tetrazolylacetic acid to regulate plant growth. Proposed for use with cereals (to reduce risk of lodging) and with sugar cane (to increase sugar concentration in cane harvest).

3,864,244 (Taylor, Eli Lilly) - Discloses compositions containing 5-pyrimidine-methanes which are plant growth regulators that inhibit internodal elongation.

3,877,921 (Timmons et al, Scott) - Discloses 2-(phenoxy alkyl) -2-oxazoline containing compositions and their use to control the growth of unwanted vegetation. These compositions can also be used to inhibit the growth of turf grasses to reduce the frequency of mowing.

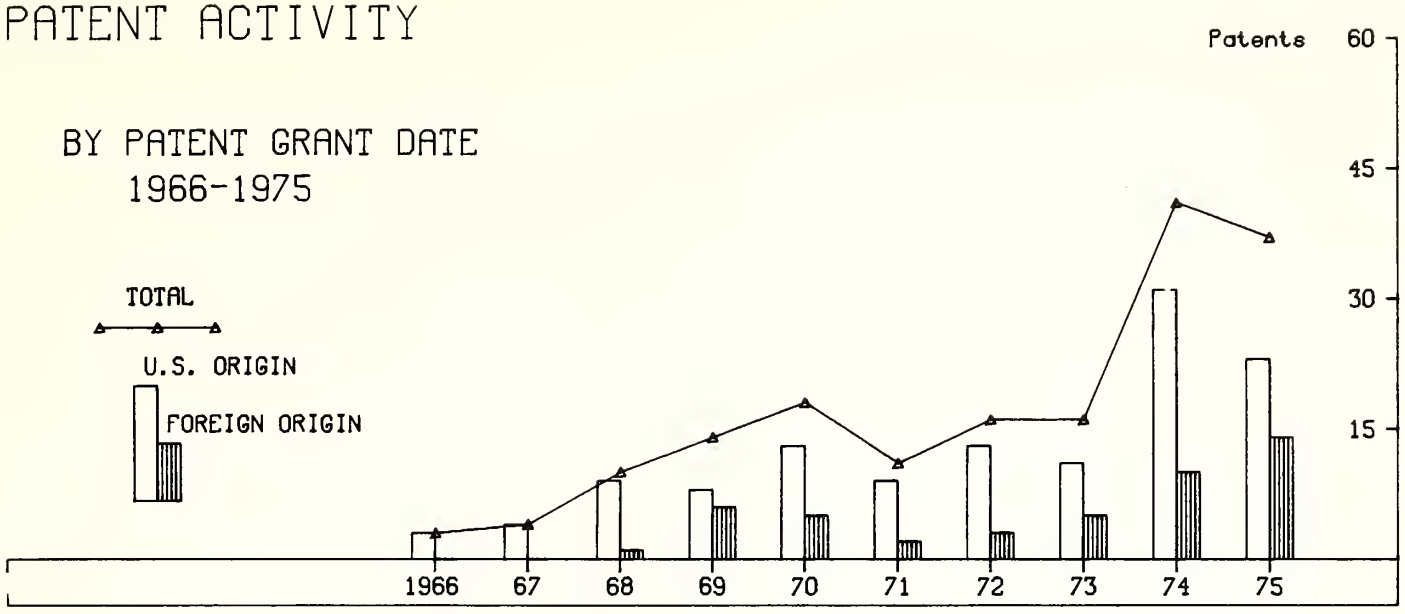
3,879,186 (Wittenbrook, Scott) - Discloses application of compositions containing 6-azauracil derivatives to inhibit upright growth of turf grass to reduce frequency of mowing.

3,883,342 (Abramitis et al, Akzona) - Discloses compositions containing long-chain N-alkenyl succinimides that are plant growth regulators (when applied at correct concentrations), and which increase yields and facilitate mechanical cultivation and harvesting.

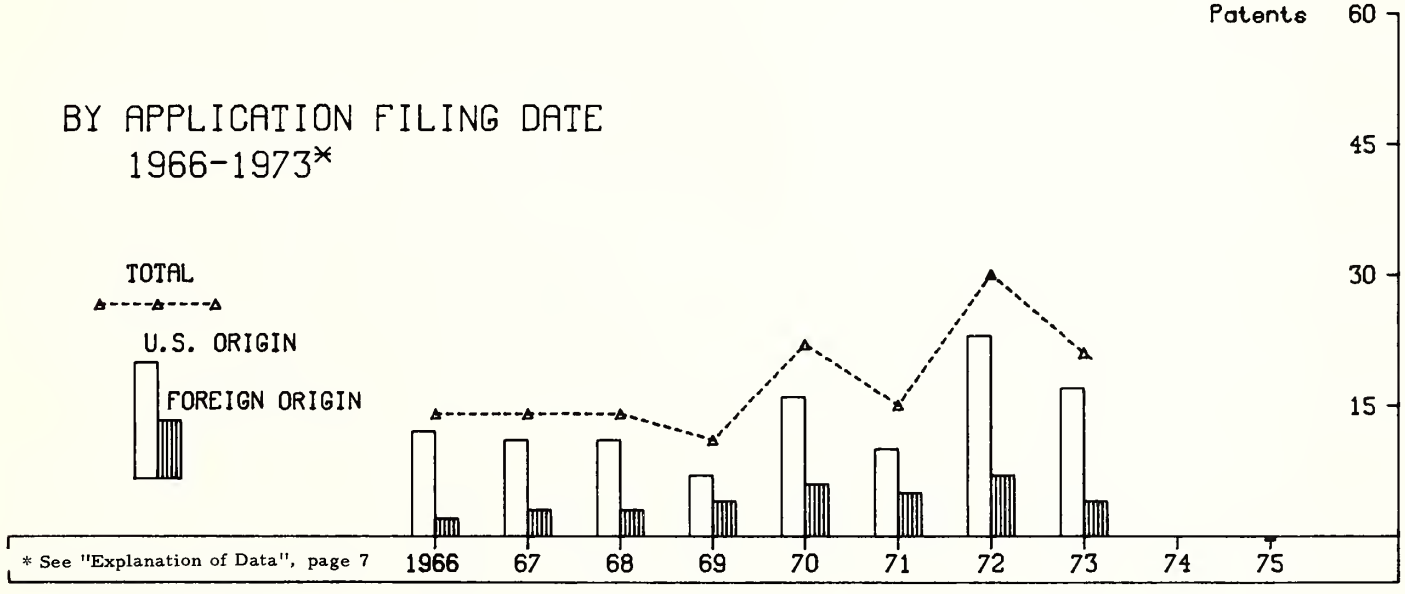
3,879,188 (Fritz et al, Amchem Products, Inc.) - Discloses phosphonic acid compounds that produce many plant growth regulating responses including preventing lodging and hastening color promotion in fruit.

PATENT ACTIVITY

BY PATENT GRANT DATE 1966-1975



BY APPLICATION FILING DATE 1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-75
TOTAL PATENTS	3	4	10	14	18	11	16	16	41	37	170	14	14	14	11	22	15	30	21	141
UNITED STATES	3	4	9	8	13	9	13	11	31	23	124	12	11	11	7	16	10	23	17	107
TOTAL FOREIGN			1	6	5	2	3	5	10	14	46	2	3	3	4	6	5	7	4	34
GERMANY			1	2	2		1	2	2	6	16		1	1	1	3	1	3	2	12
SWITZERLAND							1	1	4	4	10					2	2	2		6
UNITED KINGDOM					1			1	2	3	7			1	1	1		1	1	5
JAPAN				2	1	2			1	1	7	2	1		1		1		1	6
CANADA				1				1			2		1				1			2
BELGIUM					1		1				2			1	1					2
AUSTRIA									1		1							1		1
AUSTRALIA				1							1									
FRANCE																				

OLEFIN DISPROPORTIONATION

Processes for catalytically converting olefins or acetylenes into longer and shorter unsaturated hydrocarbons in a specific manner as indicated by: $2A \rightleftharpoons B+C$. Catalysts include molybdenum, tungsten, or rhenium oxides on alumina or silica support. Commercial applications include conversion of readily available propylene into high purity ethylene and butenes useful in the preparation of polyethylene, butadiene rubbers, high octane gasoline, or long-chain linear olefins (e.g., decene-1 for synthesis of bio-degradable detergents). (Class 260, subclass 683D)

Average Annual Activity Indices (1973-75)

Growth	17.4%	Corporate Owned	97.0%
Foreign Share	24.2%	Government Owned	0.0%

Recent Activity

This is a recently developed technology with its beginnings in the mid-1960's. One of the earlier patents was 3,261,879 to Banks and Phillips who disclosed an olefin disproportionation process which purported to achieve 95% conversion of propylene to ethylene and butenes using a catalyst of molybdenum oxide or tungsten oxide on alumina. Recent activity has focused on improving the yield in these reactions by modifying the catalyst used. Patents, issued since February 1974, include:

3,792,108 (Arganbright, Petro-Tex.) - Discloses the reaction of isobutylene and butene-2 with a catalyst composed of MoO_3-Re_2O_7 on a alumina support which has been treated with a fluoride salt. The products are 2-methyl-2-butene, an immediate pre-cursor of isoprene (for synthetic rubber) and propylene (for polypropylenes).

3,829,523 (Singleton, Shell) - Discloses olefin disproportionation at ambient temperatures employing a molybdenum oxide or tungsten oxide catalyst on alumina or silica support with an alkyl aluminum halide co-catalyst and acetic acid catalyst promotor.

3,832,417 (Ruhle, Esso) - Discloses a catalyst composed of chromium hexacarbonyl, tetrabutylammonium chloride, and alkyl aluminum chloride (or suitable analogues) in an inert solvent for acyclic or cyclic olefin disproportionation at room temperature.

3,840,612 (Attridge et.al, ICI) - Discloses a disproportionation catalyst having a large surface area composed of an organometal complex of molybdenum, tungsten, or rhenium (e.g., rhenium allyl) chemically bonded to anhydrous alumina or silica.

3,849,513 (Doyle, Exxon) - Discloses a disproportionation process employing a Group VI transition metal carbonyl complex, e.g., quaternary ammonium salts of molybdenum carbonyls $(n\text{-}C_4H_9)_4N[Mo(CO)_5Cl]$, which has been reacted with an organometallic compound, such as, methyl aluminum chloride.

3,855,340 (Knoche, Petroliers) - Discloses a disproportionation reaction in a homogeneous solution at 0-50°C. The catalyst is an alcoholate of molybdenum or tungsten to which is added an organometallic reducing agent.

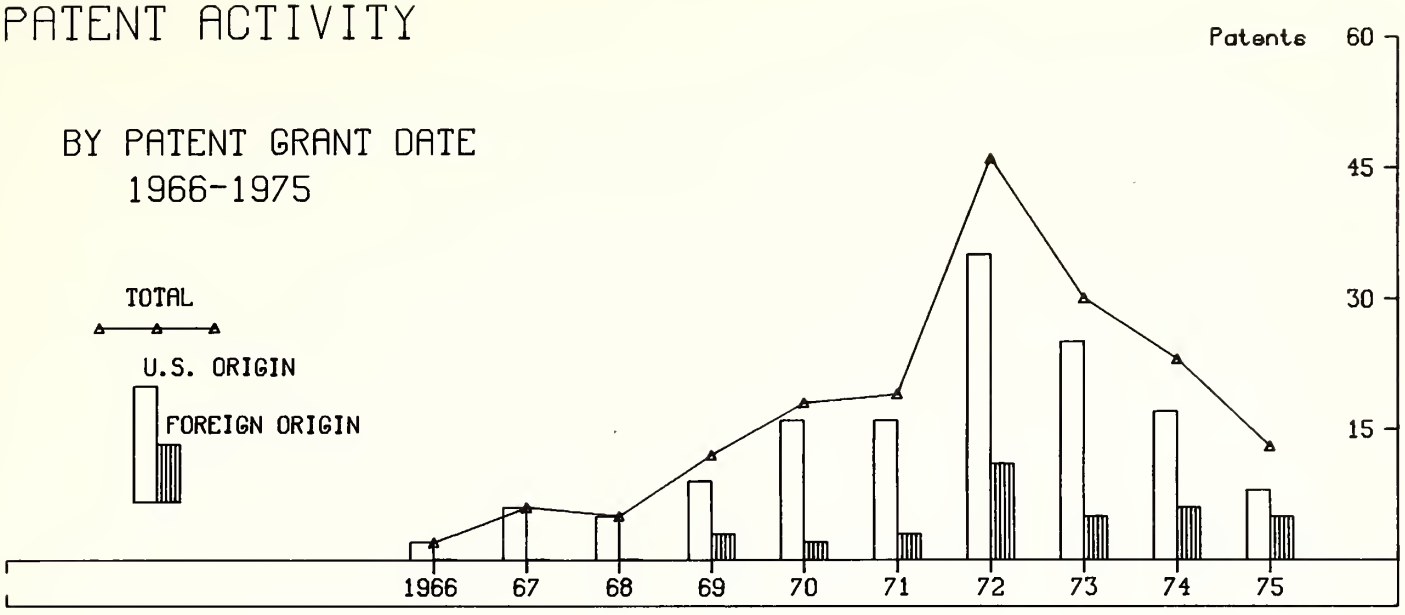
3,865,892 (Zuech, Phillips) - Discloses a catalytic process for olefin disproportionation and product dimerization or oligomerization wherein the olefin product molecular weight distribution range is controlled by varying the proportion of the following catalyst components: a molybdenum compound, a complex of nickel or chromium, and a organo-aluminum halide.

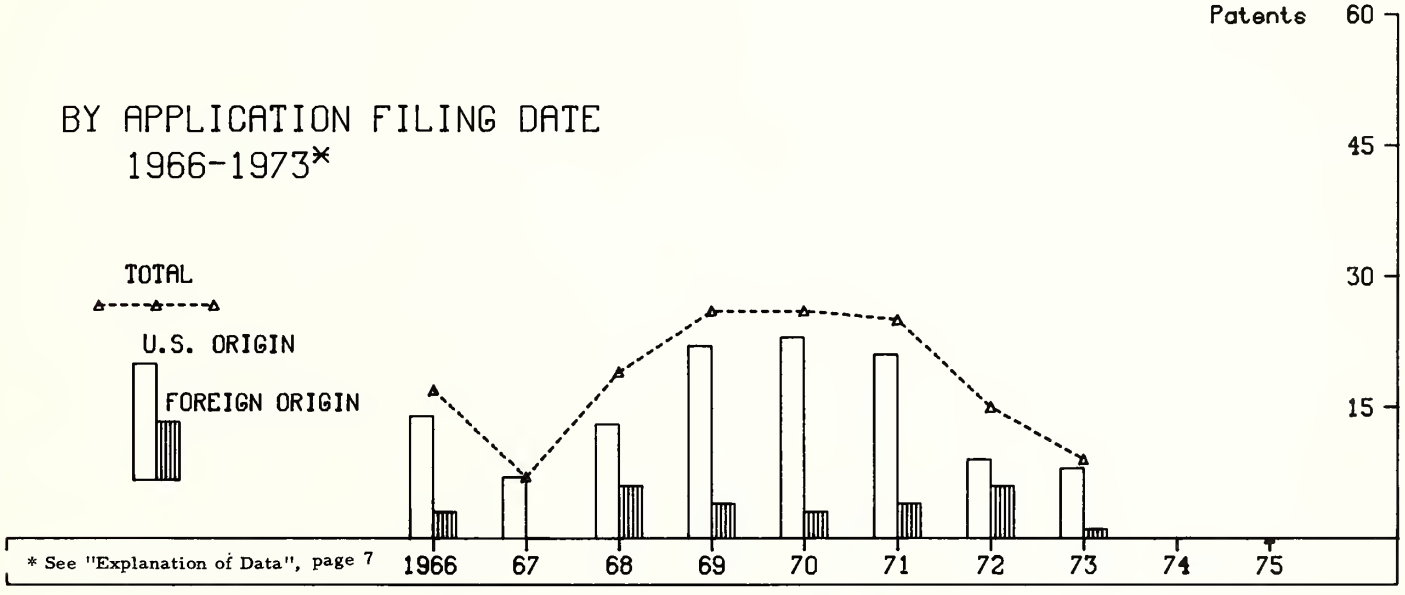
3,872,180 (Nakatomi, et.al., UBE) - Discloses a process for producing high yields of isopentene from isobutene and n-butene using a molybdenum compound catalyst and cobalt chloride on an alumina carrier.

3,888,940 (Kubicek, Phillips) - Discloses disproportionation catalysts containing molybdenum or rhenium on silica or alumina supports which are activated by heating in the presence of water or steam.

3,923,920 (Regier, Phillips) - Discloses a catalyst composed of a small amount of tungsten oxide or molybdenum oxide on a silica support treated with fluoride salt (to replace silica surface hydroxyl groups with fluoride) which gives a good yield of disproportionation and isomerization products.

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	2	6	5	12	18	19	46	30	23	13	174	17	7	19	26	26	25	15	9	144
UNITED STATES	2	6	5	9	16	16	35	25	17	8	139	14	7	13	22	23	21	9	8	117
TOTAL FOREIGN				3	2	3	11	5	6	5	35	3		6	4	3	4	6	1	27
UNITED KINGDOM				3	1	2	9	1	3	2	21	2		5	2	2	2	3		16
NETHERLANDS					1		2	2			5	1			2	1		1		5
JAPAN										3	3									
ITALY								1	1		2						2			?
FRANCE									1		1							1		1
GERMANY									1		1						1			1
ICELAND						1					1			1						1
MOROCCO								1			1							1		1

PROPAGATION OF DISCRETE CELLS

Processes and associated media to propagate and culture animal tissue having discrete cell with intact cell walls, such as those of blood or sperm; or, discrete cells from disaggregated animal tissue. Cultured animal cells are used as hosts in the production of virus vaccines, antitoxins, and antigens (Class 195, subclass 1.8)

Average Annual Activity Indices (1973-75)

Growth	22.2%	Corporate Owned	71.7%
Foreign Share	20.0%	Government Owned	6.7%

Recent Activity

Recent patent activity focuses on: 1) methods to prolong the viability of red blood cells in storage; 2) to treat red blood cells in vitro to inhibit sickle cell anemia; and 3) media and processes for culturing mammalian cells. Patents, issued since June 1974, include:

3,819,480 (Hochschild) - Discloses a methionine and 2-dimethylaminoethanol containing medium that extends the storage life of stored blood.

3,846,236 (Updike, Wisconsin Alumni) - Discloses a process for rapid transport of oxygen across a dialysis membrane and concommitant removal of carbon dioxide. Useful with artificial hearts or lungs to effect respiratory gas exchange of blood.

3,847,738 (Brake et al, American Hospital) - Discloses a method of preserving fresh blood beyond the standard 21 days by maintaining the normal 2,-3-diphosphoglycerol content of red blood cells with non-toxic dihydroxyacetone.

3,850,748 (Cook et al, Eli Lilly) - Discloses a culture vessel having an organic polymer (e.g., polypropylene) surface which permits improved cell culture suspensions in blood serum culture medium because cells do not adhere to the polymer surface.

3,852,155 (Moore) - Preserves equine cell cultures in a medium consisting of 91% animal serum (e.g. sheep or fetal bovine serum) and 9% dimethyl sulfoxide cooled to liquid nitrogen temperatures. These cultures are valuable in the preparation of equine infectious anemia vaccine.

3,856,624 (Kraus et al, Un. of Tennessee) - Carbamyl phosphate treatment of sickle cell anemia victims inhibits sickling of their red blood cells. Carbamyl phosphate, a normal constituent of the human body, initiates the urea cycle in the body, resulting in the synthesis of urea and cyanate anion, antidotes for sickle cell anemia.

3,871,955 (Klevecz) - Discloses an automatic process to produce large biochemically balanced populations of discrete mammalian cells. Cells are cultured inside roller bottles which are rotated at a sufficient speed to detach rounded mitotic cells.

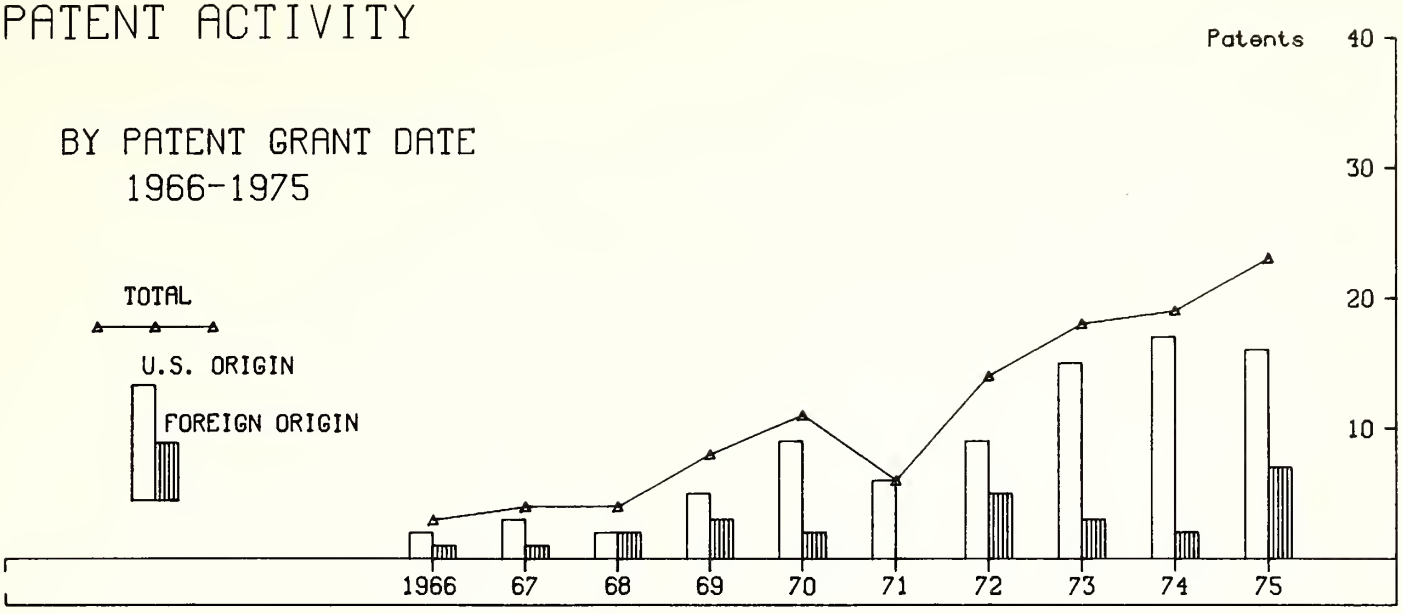
3,883,393 (Knazek et al, U.S. of A) - Process and apparatus for growing animal cells on semi-permeable membranes in an oxygenated nutrient medium. Useful cell products, such as lactic acid or hormones, diffuse through the semipermeable membrane into the perfused medium where they can be recovered.

3,884,758 (Green, MIT) - Discloses an isolated clonal cell line derived from mouse fibroblast 3T3 which has the unique characteristic of accumulating large amounts of triglyceride fats. This cell line can be used to screen drugs for their effect on cell fat accumulation.

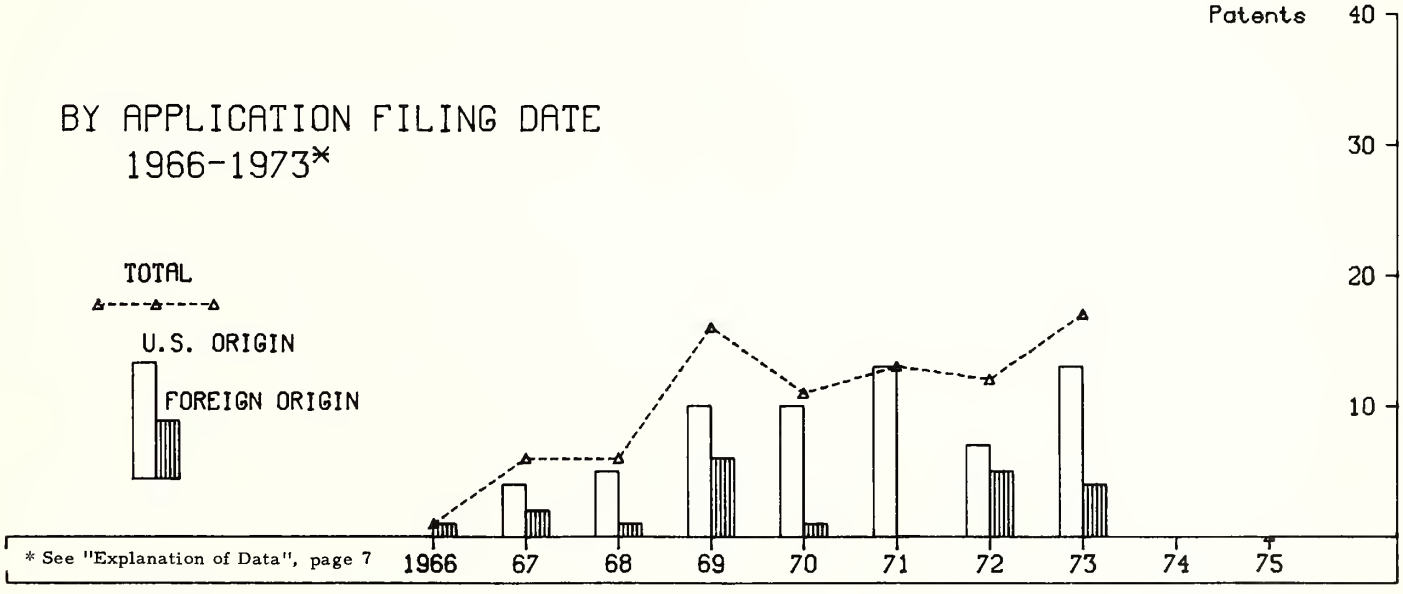
3,925,153 (Labonit, Centre d'Etudes) - Discloses a formulation containing dihydroxyacetone which gives improved blood stabilization and conservation. Dihydroxyacetone is converted intracellularly into 2, 3-diphospho-glycerol which causes the breakdown of oxyhaemoglobin, resulting in the release of oxygen to body tissues.

PATENT ACTIVITY

BY PATENT GRANT DATE
1966-1975



BY APPLICATION FILING DATE
1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	3	4	4	8	11	6	14	18	19	23	110	1	6	6	16	11	13	12	17	82
UNITED STATES	2	3	2	5	9	6	9	15	17	16	84		4	5	10	10	13	7	13	62
TOTAL FOREIGN	1	1	2	3	2		5	3	2	7	26	1	2	1	6	1		5	4	20
UNITED KINGDOM	1		2		1		2	1		1	8		1		3					4
GERMANY		1						1	2	1	5					1		3		4
FRANCE							1	1		2	4	1	1					1	1	4
JAPAN				2						2	4	1	1					1	1	4
CANADA					1		1				2			1	1					2
BELGIUM				1						1	2								1	1
USSR							1				1				1					1

FERMENTATIONS

Enzymatic reactions of hydrocarbons; proteins and amines; carbohydrates; carboxylic acids and esters; and, alcohols. Also included are enzymatic reactions that produce nucleic acid derivatives and vitamin B-12. Other products of these enzymic reactions include prostoglandins, sugars, penicillins and cephalosporins (synthesized by molds) and protein. (Class 195; subclasses 28N-36P and 49).

Average Annual Activity Indices (1973-75)

Growth	6.1%	Corporate Owned	92.9%
Foreign Share	66.0%	Government Owned	1.1%

Recent Activity

Recent activity includes fermenting processes that produce nucleic acid derivatives (e.g. inonine-5'-monophosphate) with pharmaceutical activity, L-glutamic acid seasoning agent, protein as a potential food stuff, and penicillin precursors. Also, microorganism strains have been cultured which use methanol as a carbon source. Patent activity since December 1975 includes:

3,925,154 (Enei et al, Ajinimoto) - Inosinic acid (inonine-5'-monophosphate) is produced from mutants of a Corynebacterium species acting on inosine or hypoxanthine in the presence of phosphate ions.

3,925,155 (Kondo et al, Shionigi) - 6-Aminopenicillanic acid 1-oxide, an intermediate in penicillin synthesis, is prepared by the action of a Streptomyces microorganism on penicillin 1-oxide.

3,926,725 (Ishiyama et al, Kikkoman Shoyu) - Cyclic-3', 5'-cytidylic acid (CCMP), a hormone mediator in biochemistry, is produced by fermentation with microorganisms of the genera Corynebacterium, Anthrobacter, or Microbacterium.

3,926,728 (Kondo et al, Shionogi) - 6-Aminopenicillanic acid, an intermediate in penicillin synthesis, is prepared by the action of a Phialomyces fungus on a penicillin or its salt.

3,929,575 (Miescher, Commercial Solvents) - High yields of glutamic acid, (a seasoning agent) are obtained by adding ammonium acetate fermenting medium and keeping the carbon dioxide content of the exhaust air below 6.5%.

3,929,576 (Reinhold, Merck) - 3-Fluoro-D-alanine, a potent antibacterial agent, is prepared from fluoropyruvic acid by asymmetric synthesis using a D-amino acid oxidase enzyme and D-proline, an asymmetric amino acid.

3,930,947 (Morinaga et al, Ajinomoto) - A significant amount of protein, potentially useful for food, is obtained from the cells of genus Methylomonas (a strain of soil bacteria) grown on a culture medium with methanol as the main carbon source.

3,930,948 (Sano et al, Ajinomoto) - A decarboxylase enzyme in the cells of micrococcus strains converts tryptophan and phenylalanine amino acids to the corresponding phenyl-and indolyl-ethylamines, useful in medicine.

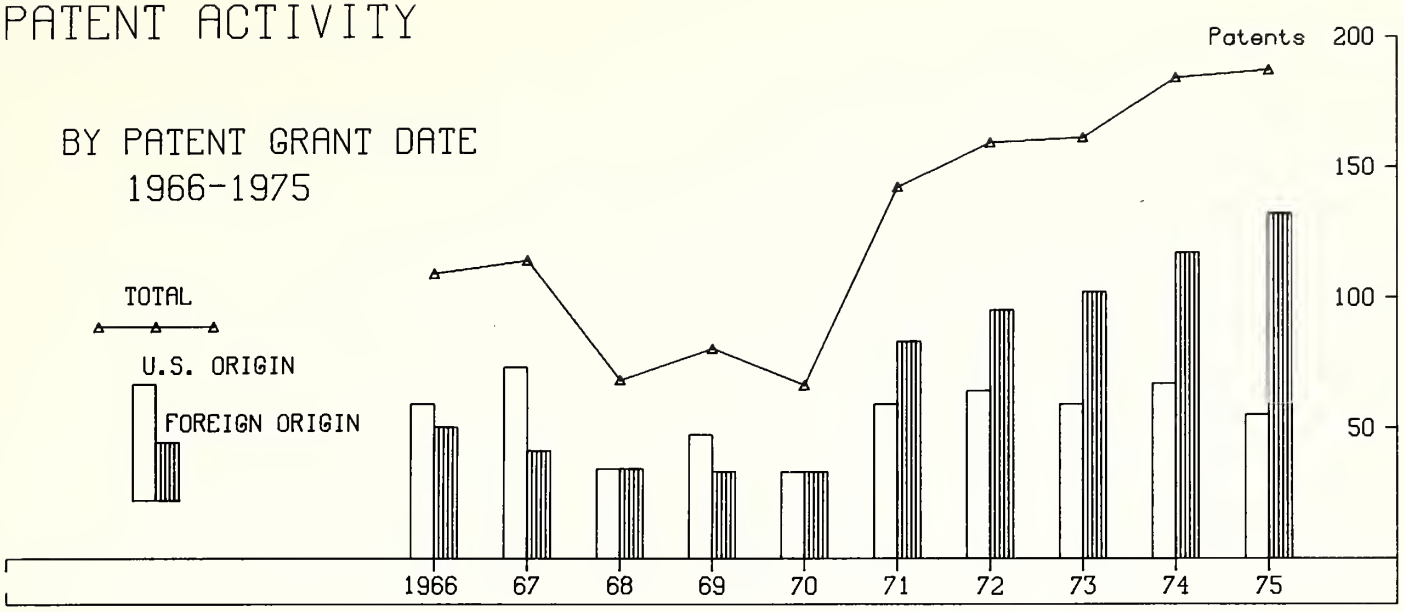
3,930,949 (Kutzbach et al, Bayer) - 7-Amino-Δ^3- cephem derivatives, with antimicrobial activity, are produced in an enzymic reaction. The penicillinacylase enzyme is bound by covalent bonds to a water-insoluble carrier such as dextran or crosslinked agarose for use in this process.

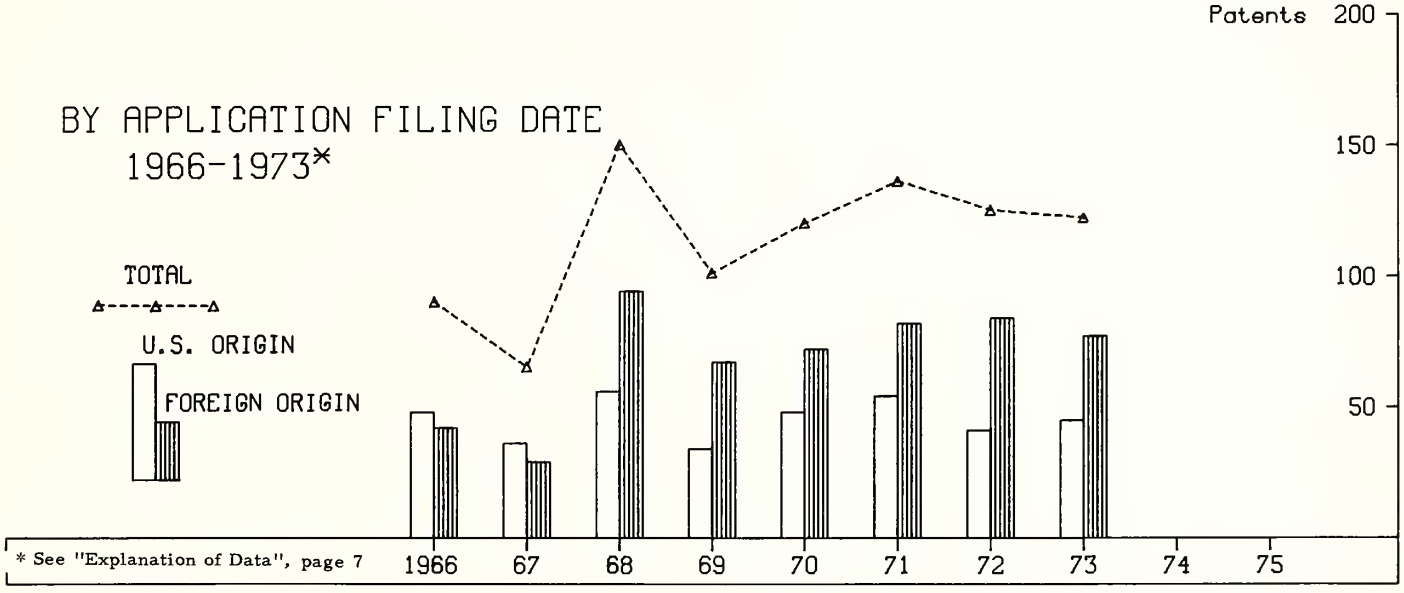
3,932,218 (Finn et al, Cornell) - A new heteropolysaccharide is produced by fermenting an aqueous culture medium containing methanol as sole carbon source with a micro-organism of the genus Methylomonas. The polysaccharide may be used as a drag reducing agent, a thickening agent, an emulsifier, or a soil suspending agent.

3,939,042 (Nakayama et al, Kyowa) - High yields of L-glutamic acid, a seasoning agent, are produced by mutant micro-organisms of the genera Pseudomonas and Protaminobacter in a culture medium containing methanol as carbon source.

3,943,038 (Morinaga et al, Ajinomoto) - Amino acids are produced by culturing hydrogen-oxidizing bacteria of the genera Anthrobacter, Brevibacterium, and Mycobacterium in an aqueous culture medium with oxygen, hydrogen and carbon dioxide.

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	109	114	68	80	66	142	159	161	184	187	1270	90	65	150	101	120	136	125	122	909
UNITED STATES	59	73	34	47	33	59	64	59	67	55	550	48	36	56	34	48	54	41	45	362
TOTAL FOREIGN	50	41	34	33	33	83	95	102	117	132	720	42	29	94	67	72	82	84	77	547
JAPAN	24	25	23	18	19	50	75	77	76	94	481	27	11	74	48	51	60	55	47	373
UNITED KINGDOM		3	1	6	2	5	7	4	10	14	52	5	2	4	8	2	3	8	13	45
FRANCE	17		2	1	4	7	6	6	9	3	55	2	5	5	2	5	7	6	4	36
GERMANY	4	3	2	2	4	9	2	1	7	8	42	4	1	5	2	6	1	3	6	28
ITALY		1	2	1		3	2	1	2	3	15		2	2	1	1	1	1	1	9
CANADA	1	2	1	1	1		1	1	3	1	12	1	2		1	2		2		8
SWEDEN	1	2	1	1	1	2	1	2	1	1	13	1		2	1	1	3		1	9
SWITZERLAND		3			1			3	3	1	11		1			2	2	2	1	8
AUSTRIA	1	1	1		1			2	2	1	9		1			1	3	1		6
ALL OTHER (20)	2	1	1	2		7	1	5	4	6	29	2	4	2	4	1	2	6	4	25

BLAST FURNACE FUEL

Furnace fuel and its use in the process to reduce iron bearing material to iron in a blast furnace at a temperature above the fusion point of iron. (Class 75, subclass 42).

Average Annual Activity Indices (1973-75)

Growth	6.2%	Corporate Owned	88.5%
Foreign Share	76.9%	Government Owned	0.0%

Recent Activity

Recent patent activity focuses on methods of using liquid fuel in a blast furnace; producing blast furnace gas; and, injecting fuel into the blast furnace operation. Patents, issued since January 1974, include:

3,784,370 (Stephenson, Stephenson Papesch Processes, Inc.) - Discloses a method of operating a blast furnace in which the blast furnace gas is stripped of nitrogen by means of molecular sieve and recycled.

3,811,868 (Inaba et al, Cobe Steel LTD.) - Discloses a method of charging iron bearing materials into a blast furnace by way of a variable charging means (e.g. armor or collision plate) located in the upper region of the blast furnace so that the ore-coke ratio in the stock will be substantially uniform in the radial direction of the furnace.

3,811,869 (Ponghis et al, Centre National De Recherches Metallurgiques) - Discloses a process for reducing iron ore in a blast furnace wherein hot reducing gas is injected into the furnace at the lower part of the 1000 ° C level, and a reducing agent is injected into the furnace at approximately the level of the tuyeres. All injections are carried out simultaneously, so as to reduce the quantity of coke required while assuring uniform and balanced operation of the furnace.

3,837,840 (Poos et al, Centre de Recherches Metallurgiques - Centrum Voor Research in de Metallurgie) - Discloses a method of operating a shaft furnace for producing pig iron from iron oxides. Fluid hydrocarbon is injected into the lower portion of a furnace, by means of a burner. The temperature of the combustion gas, resulting from the burning of the hydrocarbon and any coke in the furnace, is at least 1,600 ° C. Reducing gas is injected at the lower part of the reserve zone and at a temperature equal to or slightly greater than the temperature of the material in the furnace at the level of injection of the reducing gas.

3,844,767 (Rheinlander) - Discloses a method of operating a blast furnace using coke as the principal fuel and carbon or hydrocarbon auxiliary fuel. The coke is charged through the top of the furnace in the normal manner while the auxiliary fuel is broken down in a reaction space located outside the hearth of the furnace. The decomposition products of the auxiliary fuel are directly introduced into the tyeres or their adjacent blow pipes which carry the hot blast.

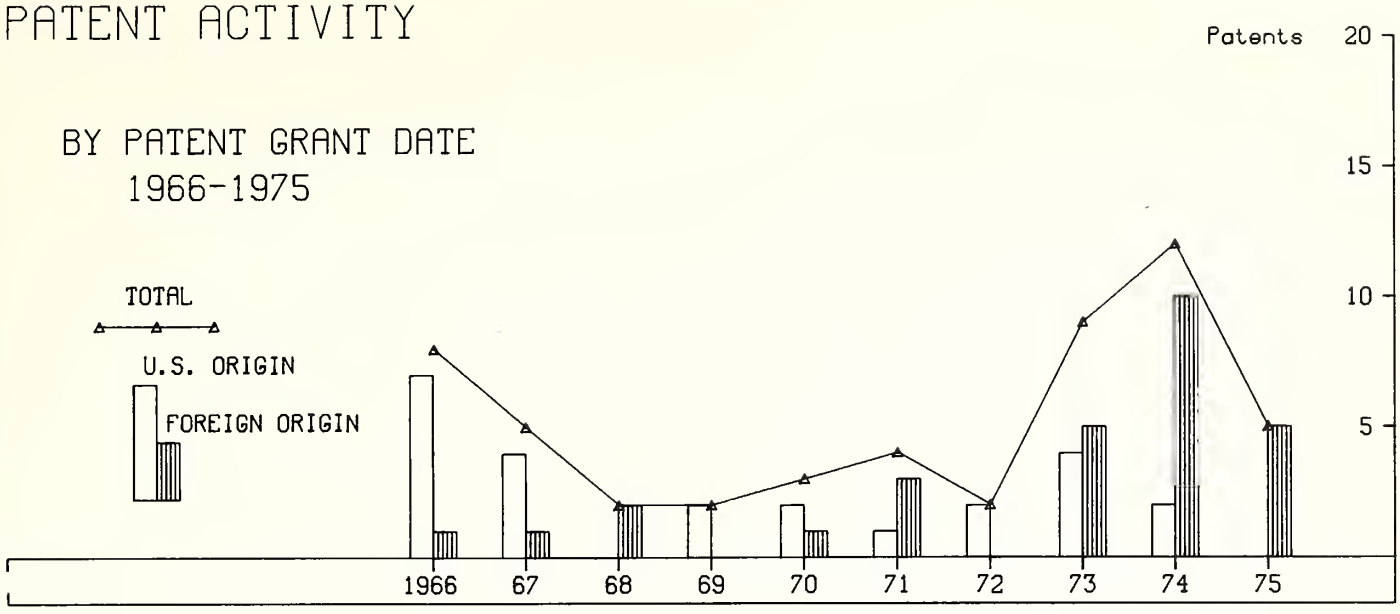
3,856,509 (Heynert et al, August Thyssen - Hutte Aktiengesellschaft) - Discloses an improvement in a process for the reduction of an iron or ore or similar material in a blast furnace wherein a water - oil emulsion (3-15% water by volume) is used as the reducing agent. The emulsion is introduced in the tuyeres of the blast furnace, and at least 90 kg of oil per metric ton of pig iron is used.

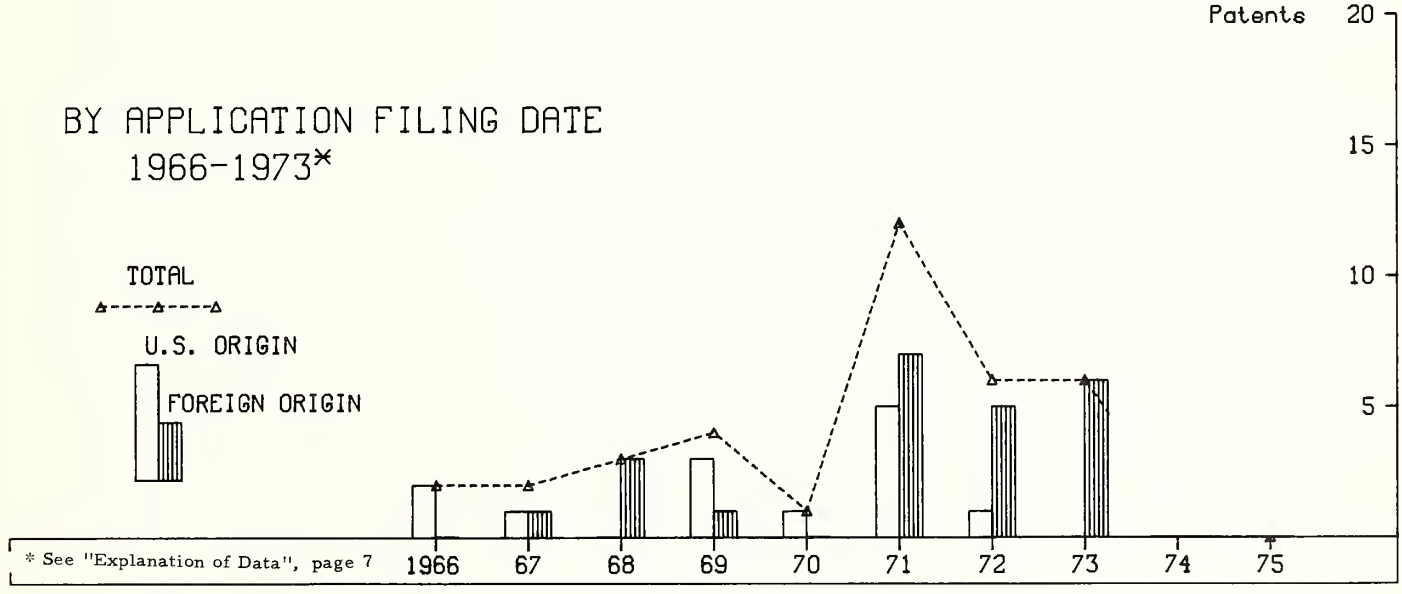
3,884,677 (Wenzel et al, Nippon Kokan Kabushiki Kaiska) - Discloses a blast furnace operation wherein blast furnace gas is regenerated by reaction with fossil fuel into a condition where it is enriched with carbon monoxide and hydrogen.

3,904,398 (Decker, Centre de Recherches Metallurgiques - Centrum voor Research in de Metallurgie) - Discloses a process for manufacturing pig iron in a blast furnace wherein hot reducing gas is injected into the iron ore-carbonaceous material charge above the zone of fusion or above the zone of softening of the charge. The gas is introduced at a temperature below that prevailing in the furnace at the place where injection occurs.

3,912,502 (Miyashita et al, Nippon Kokan Kabushiki Kaisha) - Discloses a method of preparing reducing gas containing CO and H_2 as the major ingredients, useful in the preparation of iron. Hydrocarbon oil is partially oxidized with oxygen or oxygen rich air to produce an intermediate gas containing CO and H_2O. Then CO_2 and H_2O are converted into CO and H_2O by means of a gaseous hydrocarbon (e.g. coke oven gas), using the heat generated by the partial oxidation.

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

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	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	8	5	2	2	3	4	2	9	12	5	52	2	2	3	4	1	12	6	6	36
UNITED STATES	7	4		2	2	1	2	4	2		24	2	1		3	1	5	1		13
TOTAL FOREIGN	1	1	2		1	3		5	10	5	28		1	3	1		7	5	6	23
GERMANY	1				1			3	4	1	10		1				4	1	3	9
JAPAN			1					1	1	2	5				1			1	1	3
FRANCE						2			1		3			2				1		3
ITALY		1							1		2						1			1
BELGIUM									2	1	3						2		1	3
LUXEMBOURG			1						1		2								1	1
SWITZERLAND						1					1			1						1
BULGARIA										1	1							1		1
USSR								1			1							1		1

AUTOMATICALLY CONTROLLED HYDRAULIC TYPE POWER PLANTS

Power plants consisting of a pump for flowing or pressurizing a liquid or gaseous motive fluid and a motor for converting such pressure or flow to useful work wherein the fluid output from the pump is controlled automatically in response to certain monitored conditions such as motor fluid output. Power plants, such as power steering systems, hydraulic transmission systems, and hydraulic elevators, are found here. (Class 60, subclass 445)

Average Annual Activity Indices (1973-75)

Growth	21.0%	Corporate Owned	94.8%
Foreign Share	31.0%	Government Owned	0.0%

Recent Activity

Recent activity is directed toward improving the control of the pump, usually by modification of existing control devices. Patents which have issued since April 1973 include:

3,726,093 (Malott, Parker-Hannifin) - Discloses a pump having a directional control valve with variable area orifice. The valve regulates fluid output in response to motor load pressure.

3,762,165 (Takemashita et al, Hitachi) - Discloses a hydraulic elevator with a pump which functions as a motor by receiving fluid from a hydraulic cylinder during descent of the elevator. When serving as a motor, the pump discharge volume is regulated in response to the speed and position of the elevator.

3,769,800 (Winter, Bosch GmbH) - Discloses a proportional derivative pump control device to provide a desired pump output faster and with increased stability.

3,771,310 (Cryder et al, Caterpillar Tractor) - A hydrostatic transmission control in a track vehicle which has a pair of independent transmission systems. The displacement of each transmission system pump is varied and coordinated by a control valve system responsive to vehicle speeds in each of two transverse directions.

3,846,982 (Rometsch et al, Robert Bosch GmbH) - Discloses a hydrostatic vehicle transmission system which prevents excessive pressure drop in the high pressure (pump output) line during coasting. A spring biased reciprocating valve regulates fluid pressure in the high and low (pump input) pressure lines and prevents pressure drops which disable pump control capability.

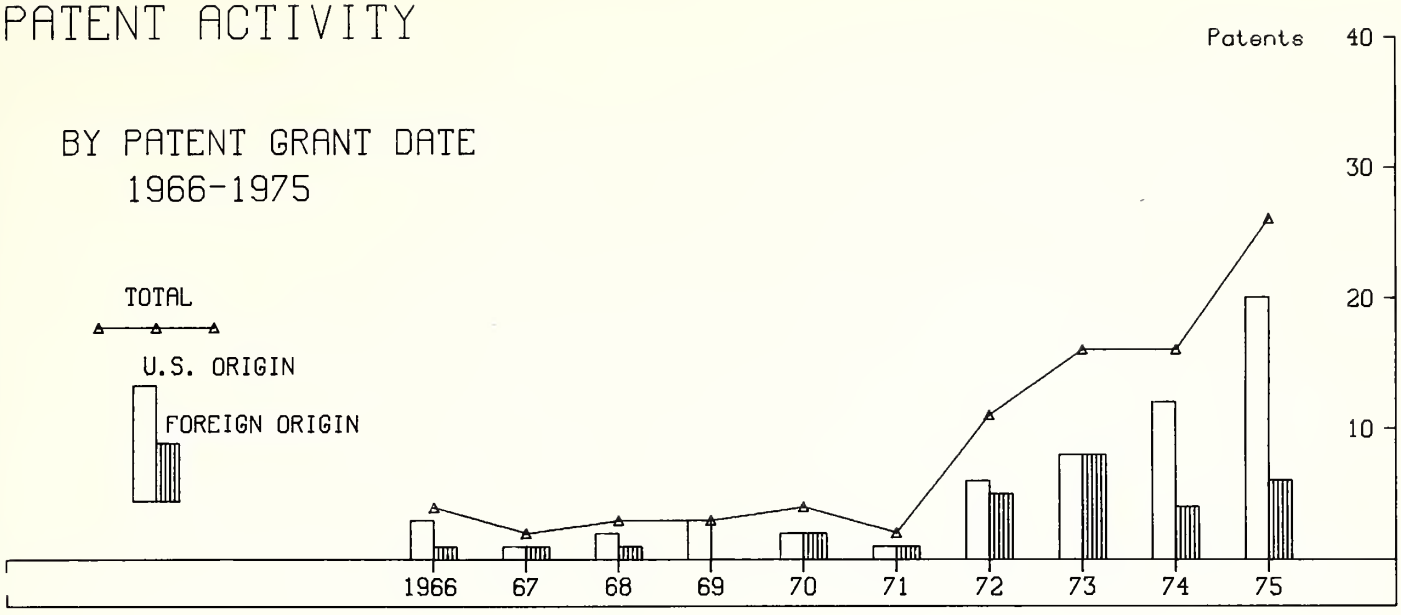
3,866,420 (Appel, Rexroth GmbH) - Discloses a device for keeping constant the speed of a hydraulic motor linked to a variable speed engine. The device consists of an auxiliary pump and motor which adds or removes fluid from respective chambers of a differential piston/cylinder unit to provide constant speed.

3,902,320 (Marietta, Parker-Hannifin) - A vehicle power steering system with a steering cylinder and a pressure compensated variable displacement pump. To control the pump output, a modulator is used which senses the pressure drop across a variable area orifice in a steering control valve. A remote ground-driven fixed displacement pump controls the modulator to vary steering response in relation to the ground speed of vehicle.

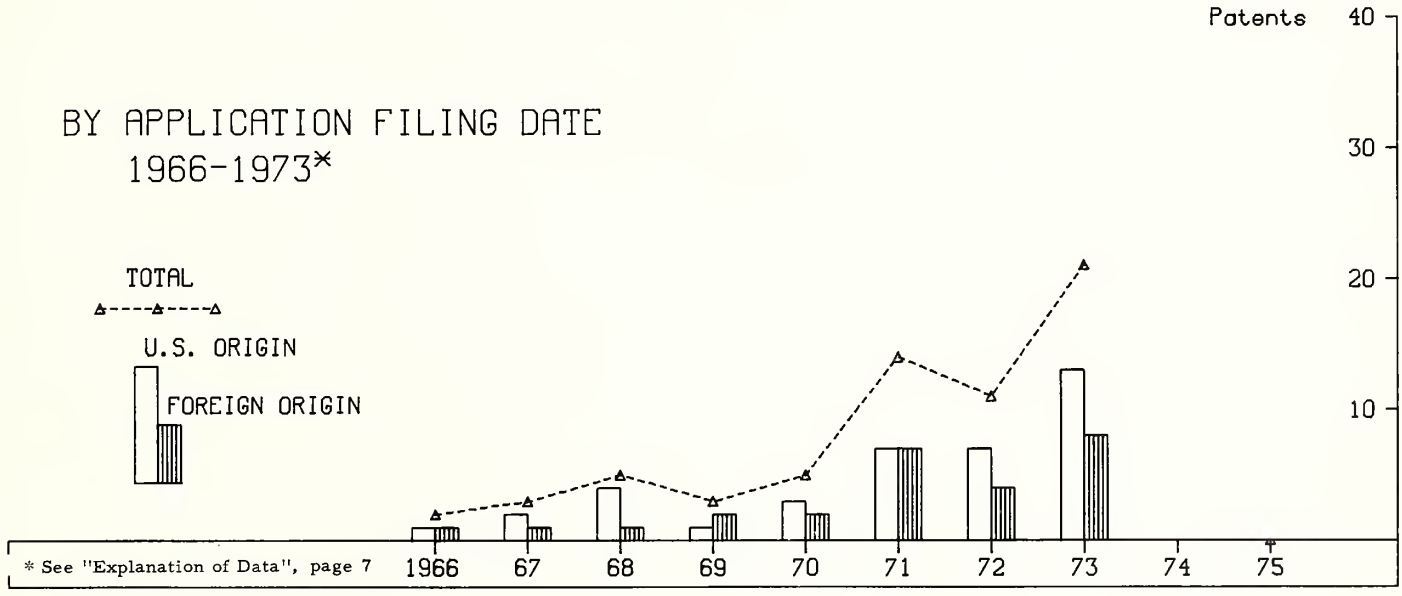
3,908,377 (Riedhammer, Hydromatik GmbH) -Discloses a hydrostatic transmission control system which employs an auxiliary pump for delivery of hydraulic fluid to the transmission circuit. A bleeder valve operates in conjunction with the auxiliary pump to provide a capacity regulating mechanism for the hydrostatic pump.

PATENT ACTIVITY

BY PATENT GRANT DATE
1966-1975



BY APPLICATION FILING DATE
1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	4	2	3	3	4	2	11	16	16	26	87	2	3	5	3	5	14	11	21	64
UNITED STATES	3	1	2	3	2	1	6	8	12	20	58	1	2	4	1	3	7	7	13	38
TOTAL FOREIGN	1	1	1		2	1	5	8	4	6	29	1	1	1	2	2	7	4	8	26
GERMANY	1					1	1	5	3	2	13				1		4	3	4	12
UNITED KINGDOM			1		2		1	1	1	3	9	1	1	1		1	1		3	8
JAPAN							1	1		1	3				1		1		1	3
FRANCE							1				1					1				1
SWEDEN							1				1						1			1
YUGOSLAVIA		1									1									
CZECHOSLOVAKIA								1			1							1		1

ELECTROMAGNETIC FLUID PUMPS

Fluid pumps in which an electrically conductive fluid is subjected to a pumping force by the interaction of a current flowing in the fluid and a magnetic field. The current and the magnetic field are perpendicular to each other and both are perpendicular to the fluid flow. This type of pump is generally used to develop small pressure heads in highly corrosive fluids and molten metals such as the liquid sodium coolant in nuclear reactors. (Class 417, subclass 50)

Average Annual Activity Indices (1973-75)

Growth	4.7%	Corporate Owned	80.0%
Foreign Share	83.3%	Government Owned	3.3%

Recent Activity

Recent developments have been directed toward improving resistance to highly corrosive environments, and improving flexibility and efficiency. Patents, issued since January 1974, include:

3,785,744 (Carbonnel, Groupement Atomique Alsacienne Atlantique) - Discloses stackable active pump elements (current electrodes and magnetic flux gaps) to make pump capacity more easily adaptable to user requirements.

3,787,143 (Carbonnel et al, Groupement Atomique Alsacienne Atlantique) - Discloses an immersion pump for liquid metals. The lower submerged portion of the pump is protected from the corrosive liquid by a refractory material. The unsubmerged induction windings are protected from corrosive vapors by a cast aluminum steel housing.

3,801,223 (Bykhovsky) - Discloses a method for producing jets of liquid metal using electromagnetic action to cause rotation of the liquid contained in a cylindrical container and tapping the high pressure fluid then available at the periphery of the cylinder.

3,807,903 (Gelfgat et al) - Discloses a means of controlling the flow rate of a conductive fluid in a magnetic field by deliberately causing variations in flux intensity along the flowpath (as by protrusions in the magnetic poles). These in turn generate large induced electrical currents in the fluid which dissipate heat energy at the expense of flow energy. Control of the magnetic field intensity controls the flow rate with precision.

3,809,497 (Carbonnel et al, Groupement Atomique Alsacienne Atlantique) - Discloses improved electrode materials for inducing electrical current flow across corrosive liquid metals. The electrode parts that are placed in contact with the liquid metal are coated with a conductive ceramic material which is resistant to corrosion.

3,829,243 (Carbonnel et al, Groupement Atomique Alsacienne Atlantique) - Discloses improved electrodes consisting of porous ceramic material impregnated with the same metal as that to be pumped. This ensures good wetting of the electrodes which both reduces resistance and simplifies the production of a fluid tight seal at the electrode.

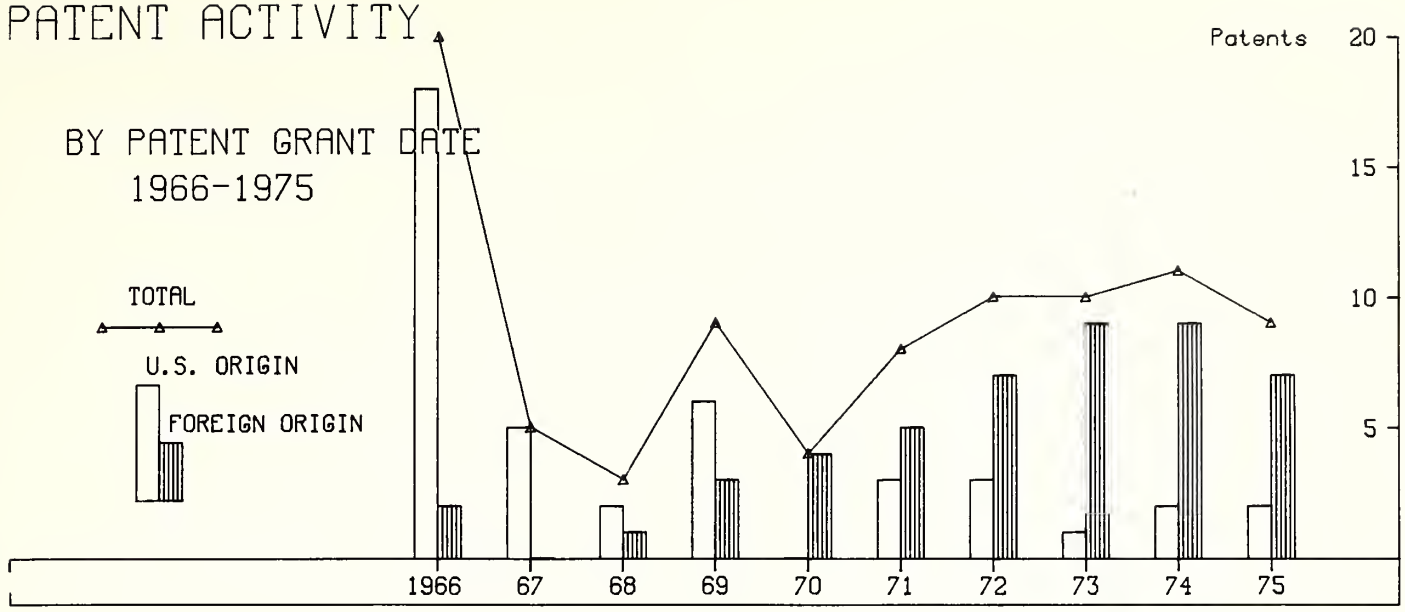
3,836,286 (Malaval, Groupement Atomique Alsacienne Atlantique) - Uses a rotating magnetic field to impart a rotational energy to a fraction of the fluid to be pumped. This rotating fluid is then recombined with the remaining fluid in spiral passages, converting the rotational energy to a pressure head.

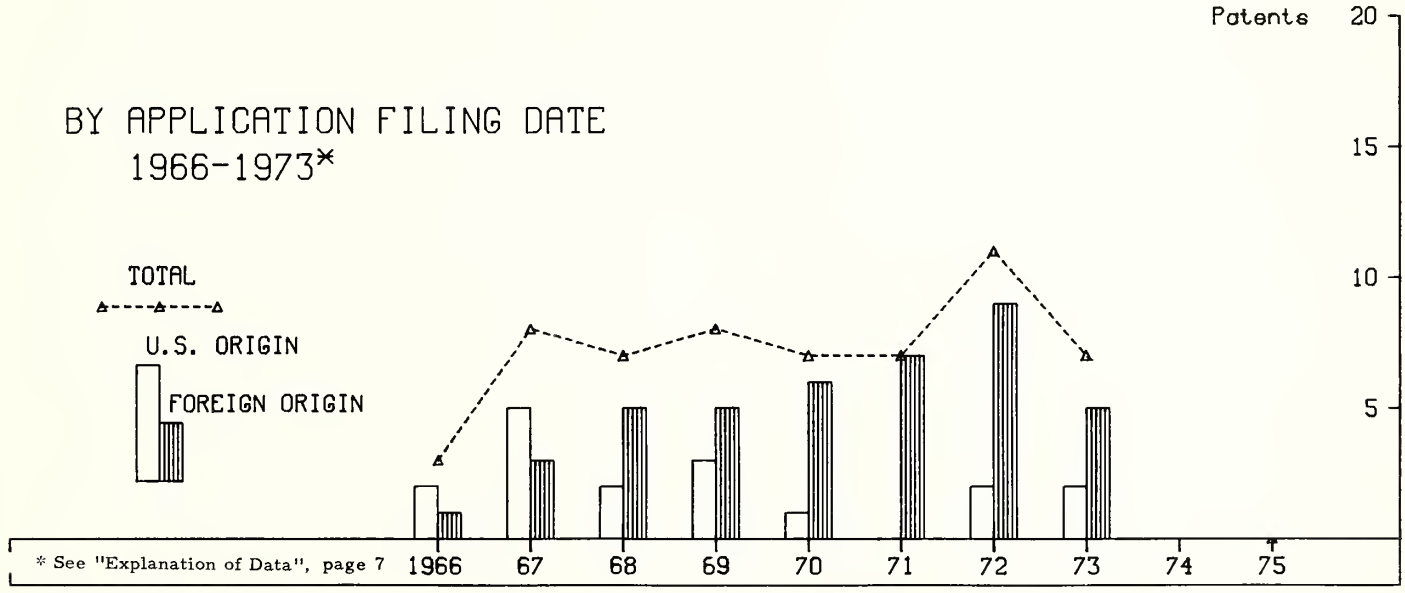
3,837,763 (Ertraud et al, Groupement Atomique Alsacienne Atlantique) - Eliminates the necessity for electrodes by forming the entire current conducting loop with openings which fill with the fluid being pumped. Electrical current is induced in this fluid loop by means of a coil.

3,864,061 (Carbonnel et al, Groupement Atomique Alsacienne Atlantique) - Discloses a technique for holding constant the output of a pump partially submerged at the falling surface of liquid metal in a crucible. As the pump is lowered an output trough is lowered an equal amount, allowing the pump to work against a constant head.

3,885,890 (Davidson, United Kingdom Atomic Energy Authority) - Discloses a pump for liquid sodium where the fluid is driven through an annular passage by a three-phase helical coil inside the annulus.

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	20	5	3	9	4	8	10	10	11	9	89	3	8	7	8	7	7	11	7	58
UNITED STATES	18	5	2	6		3	3	1	2	2	42	2	5	2	3	1		2	2	17
TOTAL FOREIGN	2		1	3	4	5	7	9	9	7	47	1	3	5	5	6	7	9	5	41
GERMANY				1	3	2	4	7	1	2	20		1	4	2	4	4	3	1	19
FRANCE	2			1		1	1		6	1	12		1		1	1		4	3	10
UNITED KINGDOM			1	1	1					1	4	1	1						1	3
USSR						1		1	2	1	5				1		2	1		4
SWEDEN							1	1			2					1	1			2
ITALY						1	1				2			1	1					2
JAPAN										1	1									
CANADA										1	1							1		1

ROTARY SCREEN PRINTING MACHINES

Devices for the printing of sheet materials which have a rotating cylinder carrying a peripheral stencil or screen. A supply of a ink or dye is forced from within the cylinder screen onto the sheet material which is supported on its other side by another rotating cylinder or a moving belt. The process is particularly adaptable to the printing of fabrics and may be used to dye patterns on rugs. With electronically controlled multiple cylinders, complex multicolored patterns may be achieved. (Class 101, subclass 119)

Average Annual Activity Indices (1973-75)

Growth	7.5%	Corporate Owned	68.2%
Foreign Share	77.3%	Government Owned	0.0%

Recent Activity

Recent activity has been directed toward achieving better control of the ink or dye flowing through the cylinder screen to the material to be printed. The internal feeding and distributing device, known in the art as a squeegee, forces liquid through the screen at the area of contact with the printing material. Improvements in squeegee design have led to much higher printing speeds as well as better reliability. Patents, issued since November 1973, include:

3,774,533 (Ichinose) - Prevents unwanted ink flow during printing stoppage by rotating the printing cylinder with a separate drive means when it is raised from the printing position.

3,774,534 (Ichinose) - Eliminates stoppage of the printing operation when setting up new stencil screens or changing ink by printing with a plurality of cylinders. Alternate cylinders are engaged in printing while the others are being set up for the next operation.

3,795,188 (Giani, Reggiani S.P.A.) - Improves printing by combining a squeegee with an inclined counter pressure table which biases the work carrying belt toward the drum. Parts exposed to wear are easily replaceable.

3,804,010 (Zeuthen et al, Zeuthen & Aagaard A/S) - Discloses an improved apparatus for adjusting the liquid supply to selected zone ducts of a drum. The drum drive is temporarily utilized to align apertures with the liquid ducts thus eliminating the need for manual adjustment.

3,807,302 (Kudlich, Peter Zimmer) - Inserts an air-foil-shaped guide wall in the application zone of a roller type squeegee to increase the hydrodynamic pressure of the ink or dye without the use of a pump.

3,859,916 (Zimmer) - Discloses a roller squeegee separately driven at approximately the same circumferential speed as the cylinder screen. This provides better liquid flow by eliminating slippage occuring when the roller is driven frictionally by the cylinder.

3,878,780 (Lotte, Societe Alsacienne de Constructions Mecaniques de Mulhouse) - Discloses a blade type squeegee regulated by a pneumatic bladder pressing against a flexible strip and the squeegee. Use of this strip with the bladder promotes uniform ink distribution by forcing the squeegee against the cylinder screen with a uniform pressure along the length of the cylinder.

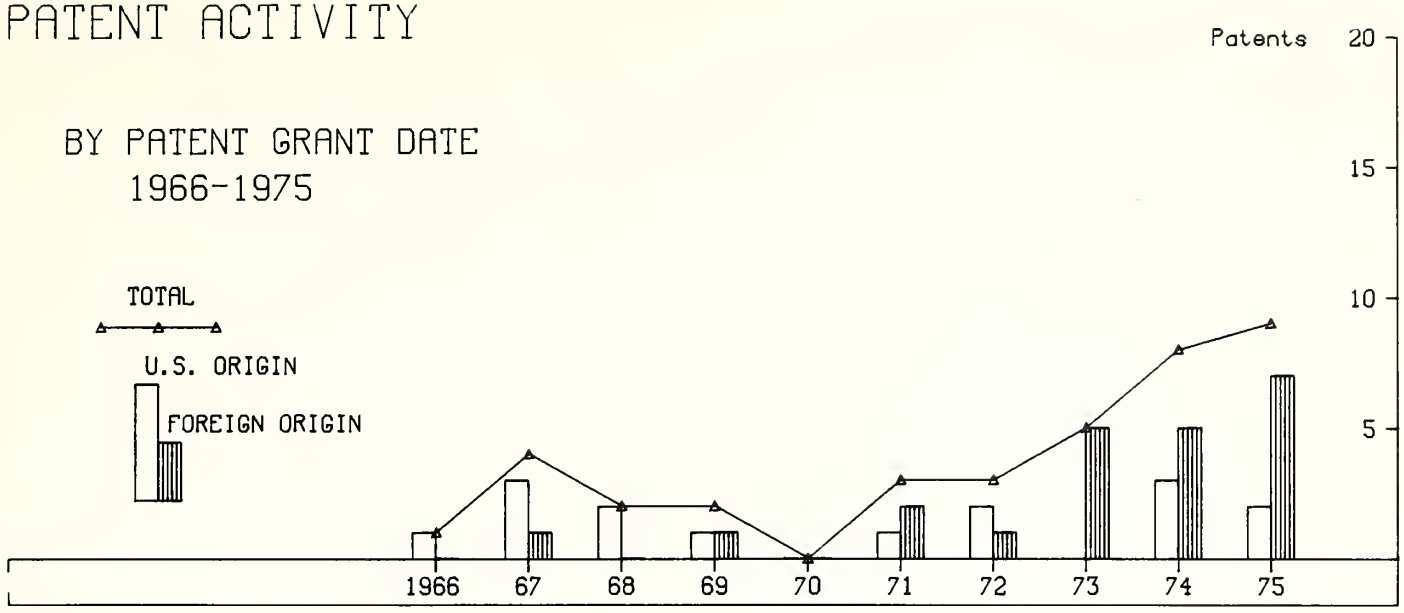
3,886,861 (Anselrode, Stork Amsterdam N.V.) - Discloses a blade type squeegee in which the angle can be adjusted independently of the blade tip pressure on the inner cylinder screen. This allows identical printing to be obtained even when a replacement blade of slightly differing elasticity is used.

3,890,896 (Zimmer) - Discloses a sealing means adapted to prevent the flow of pressurized liquid through the screen except at the desired application slot. Two flexible sealing strips are held against the inner cylinder screen by spring biased axial rods attracted by an electromagnet on the opposite side of the printed sheet.

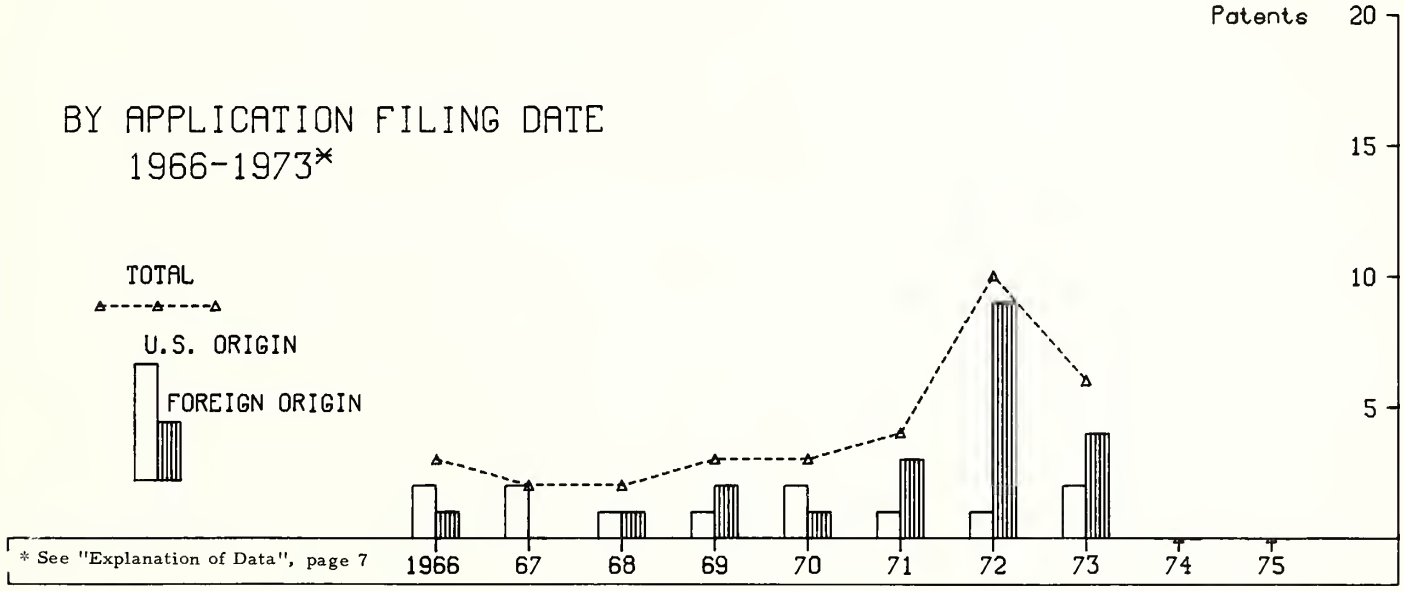
3,901,146 (Stierlein, Societe Alsacienne de Constructions Mecaniques de Mulhouse) - Discloses a blade type squeegee with an adjustable blade angle. The squeegee pressure is independently adjusted by means of an inflatable tube.

PATENT ACTIVITY

BY PATENT GRANT DATE 1966-1975



BY APPLICATION FILING DATE 1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	1	4	2	2		3	3	5	8	9	37	3	2	2	3	3	4	10	6	33
UNITED STATES	1	3	2	1		1	2		3	2	15	2	2	1	1	2	1	1	2	12
TOTAL FOREIGN		1		1		2	1	5	5	7	22	1		1	2	1	3	9	4	21
AUSTRIA									3	3	6						2	2	2	6
JAPAN				1				4			5	1					1	3		5
GERMANY						2		1		1	4			1	1	1			1	4
NETHERLANDS		1								1	2							1		1
FRANCE										2	2							1	1	2
ITALY									1		1							1		1
BELGIUM							1				1				1					1
DENMARK									1		1							1		1

TEXTILE MACHINE BOBBIN DOFFING APPARATUS

Textile filament spinning or twisting machines combined with devices for automatically removing (doffing) and/or replacing (donning) filled bobbins (spools) with empty ones. These devices may travel along the frame to successively service many bobbin winding stations or may simultaneously service all the stations. Sometimes combined with these are mechanisms for severing the filament, restarting the new bobbin, splicing broken filaments, etc. without interuption of the continuous feeding. Intricate mechanical mechanisms are used to generate the rapid and reliable complex motions required. (Class 57, subclasses 52 and 53)

Average Annual Activity Indices (1973-75)

Growth	5.2%	Corporate Owned	100.0%
Foreign Share	71.7%	Government Owned	0.0%

Recent Activity

Recent developments have been directed toward improving reliability at high speeds. Improvements have also been made in transfering empty bobbins to and full bobbins away from the tender. Attention has also been directed toward means for protecting the filament packages after winding. Patents, issuing since September 1974, include:

3,835,633 (Klein, Zinser-Textilmaschinen GmbH) - Discloses a gripper for the inside surface of a bobbin which is activated by expanding a flexible hollow member with fluid pressure. A rigid wall portion of the member gives better lateral stability.

3,844,099 (Tsuchiyama et al, Toray Industries Incorporated) - Discloses an apparatus for simultaneously doffing multiple full bobbins and transfering them to a storage cage in such a way that the filaments wound on the bobbins are never touched by any mechanism or by each other.

3,863,432 (Isobe et al, Asahi Kasei Kogyo Kabushiki Kaisha) - Discloses an automatic removal apparatus for centrifugally spun rayon "cakes" which eliminates human exposure to the irritative waste gases. A lift and a draw belt cooperate to place the cake on conveying means.

3,879,925 (Yoshizawa et al, Kabushiki Kaisha Toyoda Jidoshiokki Seisakusho and Daiwa Boseki Kabushiki Kaisha) - Discloses a high speed rotary doffer which transfers the filled bobbin from a first to a second receiving device. Each has multi-forked end portions which are interlaced to prevent mutual interference.

3,895,482 (Schulz et al, Zinser - Textilmaschinen GmbH) - Discloses an internal bobbin gripper which automatically stops or reverses upon detection of any abnormal force which would tend to damage the machine.

3,899,870 (Roller et al, C. Eugen Maier Metalverarbeitung GmbH) - Discloses a means for reliably retaining the trailed thread on the stripped spindle. A rotary brush is used to maintain the thread tension on the spindle.

3,905,184 (Takai et al, Howo Kogyo Kabushiki Kaisha) - Discloses a compact arrangement for exchanging bobbins. Auxiliary pegs are used to temporarily hold the empty bobbins so that they do not interfere with the transfer and conveying of full bobbins.

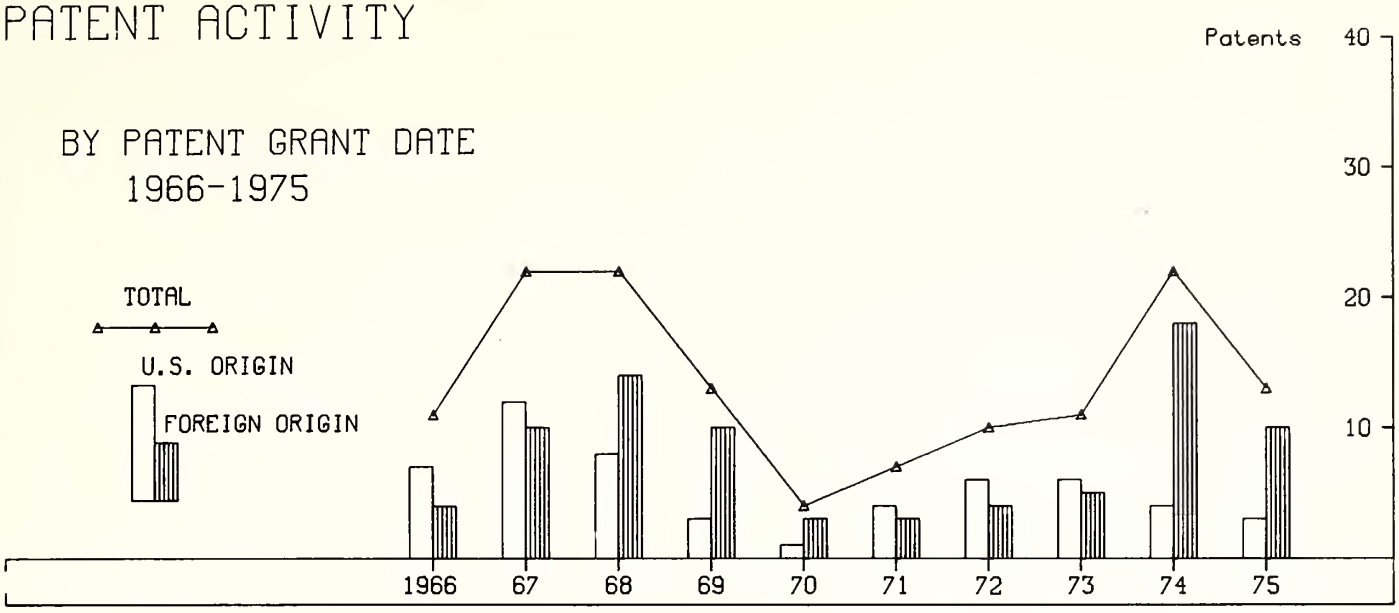
3,906,712 (Miyazaki et al Daiwa Boseki Kabushiki Kaisha and Kabushik Kaisha Toyodo Jidoshokki Siesakusho) - Discloses an improved apparatus for transfering full yarn packages to the carrying container. The packages are oriented to a preferred position while being conveyed, temporarily held above the container, and dropped into the container in an orderly manner.

3,908,348 (Hirschle et al, Rieter Machine Works Ltd.) - Discloses an apparatus capable of donning empty bobbin tubes on fixed spindles without stopping the carriage at each spindle. The tubes are oriented vertically and conveyed rearwardly with respect to the carriage at the same speed as the carriage travels forwardly. They are then dropped on the stationary spindles.

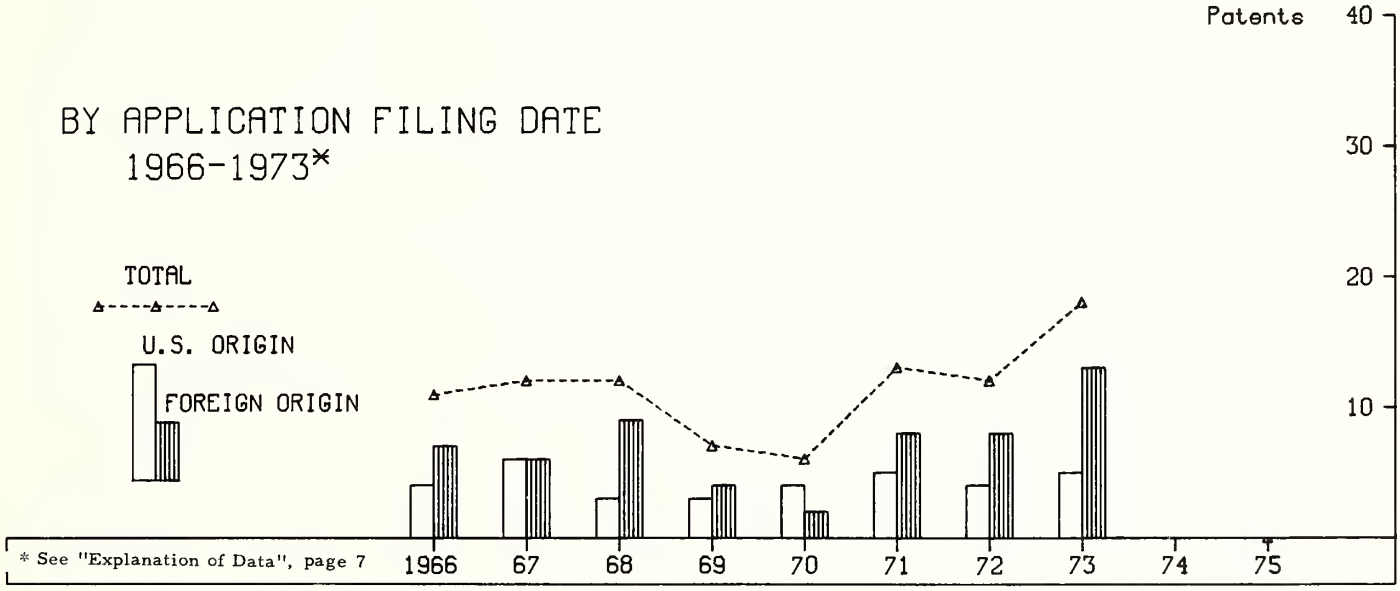
3,938,308 Komura et al, Kabushiki Kaisha Toyoda Jidoshokki Seisakusho) - Discloses an improved fresh bobbin feeding device which deposits the bobbins on alternate pegs of a continuously moving conveyor.

PATENT ACTIVITY

BY PATENT GRANT DATE
1966-1975



BY APPLICATION FILING DATE
1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	11	22	22	13	4	7	10	11	22	13	135	11	12	12	7	6	13	12	18	91
UNITED STATES	7	12	8	3	1	4	6	6	4	3	54	4	6	3	3	4	5	4	5	34
TOTAL FOREIGN	4	10	14	10	3	3	4	5	18	10	81	7	6	9	4	2	8	8	13	57
JAPAN		5	5	3	1			3	7	4	28	4	2	3			6	3	3	21
GERMANY	1	3	8	3	1		1	1	7	4	29	3	2	3	1		1	4	6	20
SWITZERLAND							3		1	2	6				1	1	1	1	1	5
UNITED KINGDOM	1			2		2					5		1	1	2					4
ITALY			1	1	1	1			2		6			2					2	4
NETHERLANDS	1	1									2									
SPAIN	1										1									
BULGARIA				1							1		1							1
FRANCE								1			1					1				1
ALL OTHER (3)		1							1		2								1	1

TRANSPORT SYSTEMS FOR CASSETTE RECORDERS

Transport systems for the storage and retrieval of information based on relative movement between a magnetic record carrier (magnetic tape) and a transducer (record-play-back-erase head). Systems included have a transducer stationary during the recording or playing process, and use a magnetic tape wound on plural reels which are enclosed in a removable container (e.g. a tape cassette). (Class 360, subclass 96)

Average Annual Activity Indices (1973-75)

Growth	30.2%	Corporate Owned	86.4%
Foreign Share	67.1%	Government Owned	0.0%

Recent Activity

Recent patents disclose a variety of improvements and innovations in transport systems for cassette tape recorders. While no one area of development predominates, basic concerns are generally efficiency, reliability, and economy of manufacture. The following patents, issued since June, 1973, disclose recent activity in this area.

3,867,722 (Syohji, Shin-Shirasuna Electric Corp.) - Discloses a cassette eject mechanism using an eject key.

3,872,509 (Yoshii, Matsushita Electric Industrial Co., Ltd.) - Discloses a tape indicator for indicating the progress of a tape being played. Includes the feature of automatically resetting the indicator to zero upon inserting or extracting the cassette.

3,877,074 (Guttinger, Compur-Werk Gesellschaft mit beschrankter Haftung & Co.,) Discloses a recorder which can be held and operated with one hand.

3,881,187 (Nakamichi, Nakamichi Research, Inc.) - Discloses a tape recorder having three heads, which can play a standard cassette in the forward or reverse direction.

3,887,943 (Katsurayama, Shin-Shirasuna Electric Corp.) - Discloses a tape recorder having an automatic power shut off at the end of a tape.

3,896,493 (Ando) - Discloses a cassette recorder with a movable tape head and pinch roller to provide a fast forward operation without head engagement.

3,902,193 (Hapke, Blaupunkt-Werke GmbH) - Discloses a cassette player recorder with a movable support to accept and eject the cassette.

3,903,544 (Nakamichi, Nakamichi Research Inc.) - Discloses a cassette tape recorder which has a pair of capstans. The tape is tensioned by having the downstream capstan operate at a higher peripheral speed.

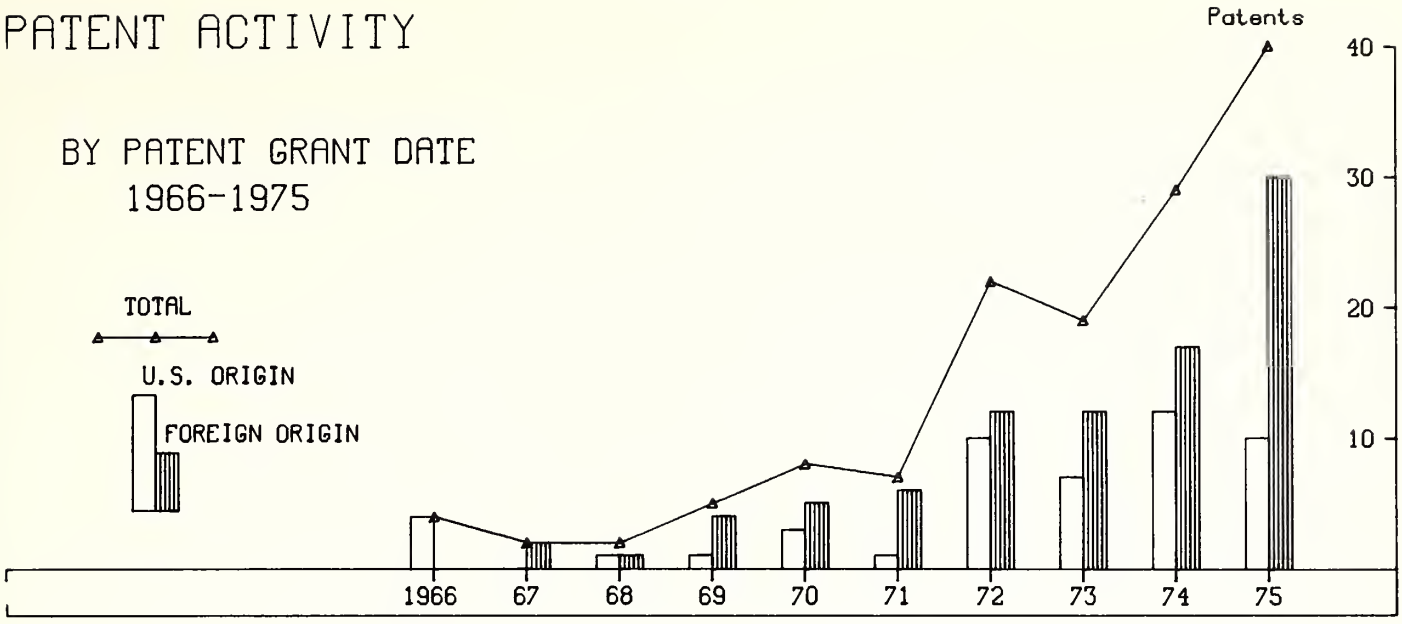
3,918,094 (Rudd) - Discloses a special tape cassette with a window for viewing the non-magnetised surface of the tape. This surface has information printed on it indicating what is recorded on the tape.

3,930,268-3,930,269 (Uemura, Teac Corp.) - Discloses arrangements for stopping the tape and providing the required back tension while a tape is being driven.

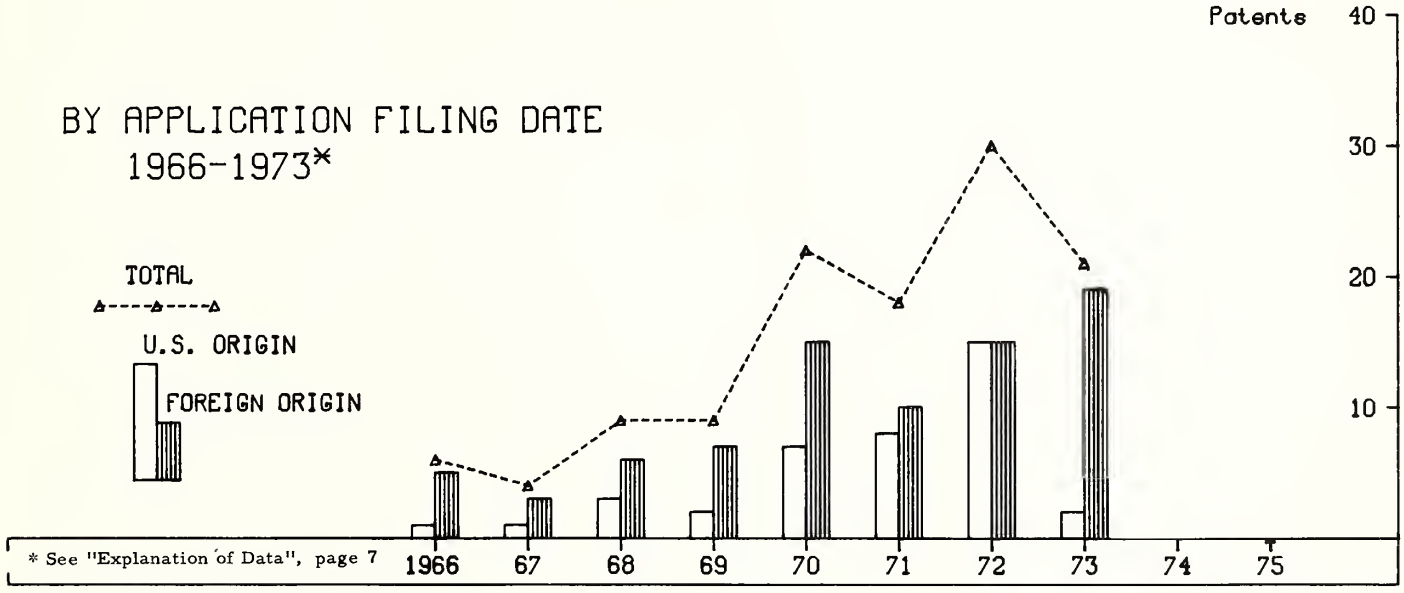
3,934,270 (Iwata, Victor Co. of Japan, Ltd.) - Discloses the use of two motors for independently driving a capstan and a reel drive mechanism to assure constant tape speed.

PATENT ACTIVITY

BY PATENT GRANT DATE 1966-1975



BY APPLICATION FILING DATE 1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	4	2	2	5	8	7	22	19	29	40	138	6	4	9	9	22	18	30	21	119
UNITED STATES	4		1	1	3	1	10	7	12	10	49	1	1	3	2	7	8	15	2	39
TOTAL FOREIGN		2	1	4	5	6	12	12	17	30	89	5	3	6	7	15	10	15	19	80
JAPAN		1		1		6	5	8	9	21	51		1	5	5	9	6	7	13	46
GERMANY		1	1	2	1		4	2	2	3	16	3			2	4	1	1	2	13
ITALY							2		2		4					1	1	1	1	4
AUSTRIA				1	2				1		4	1	2					1		4
UNITED KINGDOM									1	2	3							1	1	2
FRANCE					1					2	3			1				1	1	3
SWITZERLAND								1	1		2						1		1	2
CANADA							1			1	2					1		1		2
BELGIUM					1					1	2	1						1		2
ALL OTHER (2)								1	1		2						1	1		2

ANTIPOLLUTION DEVICES

Processes and associated apparatus for disposing of smoke and fumes produced while charging or discharging hot distillation chambers. Most frequently, these are employed in the manufacture of coke to control polluting gases formed when hot coke comes into contact with the atmosphere upon leaving the oven. (Class 202, subclass 263)

Average Annual Activity Indices (1973-75)

Growth	22.1%	Corporate Owned	91.8%
Foreign Share	49.0%	Government Owned	0.0%

Recent Activity

Recent patent activity focuses on controlling pollution formed in the commercial carbonization of coal. Various devices have been developed to capture and clean the polluting gases and entrained coal dust before they are released. Patents, issued since January 1974, include:

3,785,933 (Edgar et al, Koppers) - Discloses a gastight hood mounted to a coke guide car. The hood is provided with a collar that cooperates with a fixed gas collecting main and with curtains to prevent gases, smoke and dirt from escaping from the quenching car while coke is being pushed from a coke oven chamber.

3,785,934 (Clarke, Koppers) - A water system for a larry car equipped with water-scrubber type dust eliminator for removing dirt and particulate material from the gases which evolve during the charging of a coke oven chamber. Clean water for the scrubbers is obtained from a circulating water header loop extending the length of the coke oven. A dirty water storage tank on the larry car is emptied simultaneously with the charging of coal into the coke oven.

3,801,473 (Schoen et al, Birresbom) - A coke carriage carries a fume-collecting hood projecting laterally over a quencher car. An exhaust pipe is secured to the hood to suppress emission of dust-containing waste gases into the atmosphere.

3,830,729 (King, Woodall-Duchan) - Discloses a breeches pipe carriage for charging a battery of horizontal coke ovens which minimizes the amount of charging gases and coal dust discharges into the atmosphere.

3,840,436 (Lorrek, Heinrich Koppers) - A rotary drum is positioned adjacent to the discharge end of a coke oven chamber to receive coke pushed from the chamber through a coke guide. Air cleansing devices and a water spray device remove dust generated and quench the coke as it is discharged from the coke oven.

3, 844,901 (Roe et al, Great Lakes Carbon) - Discloses an entrapment structure for reducing gaseous and particulate emissions from a side battery of coke ovens into the atmosphere.

3,862,889 (Lowe, Interlake) - Effluent collectors and a sub-atmospheric pressure are used to prevent the emission of effluents from coke ovens.

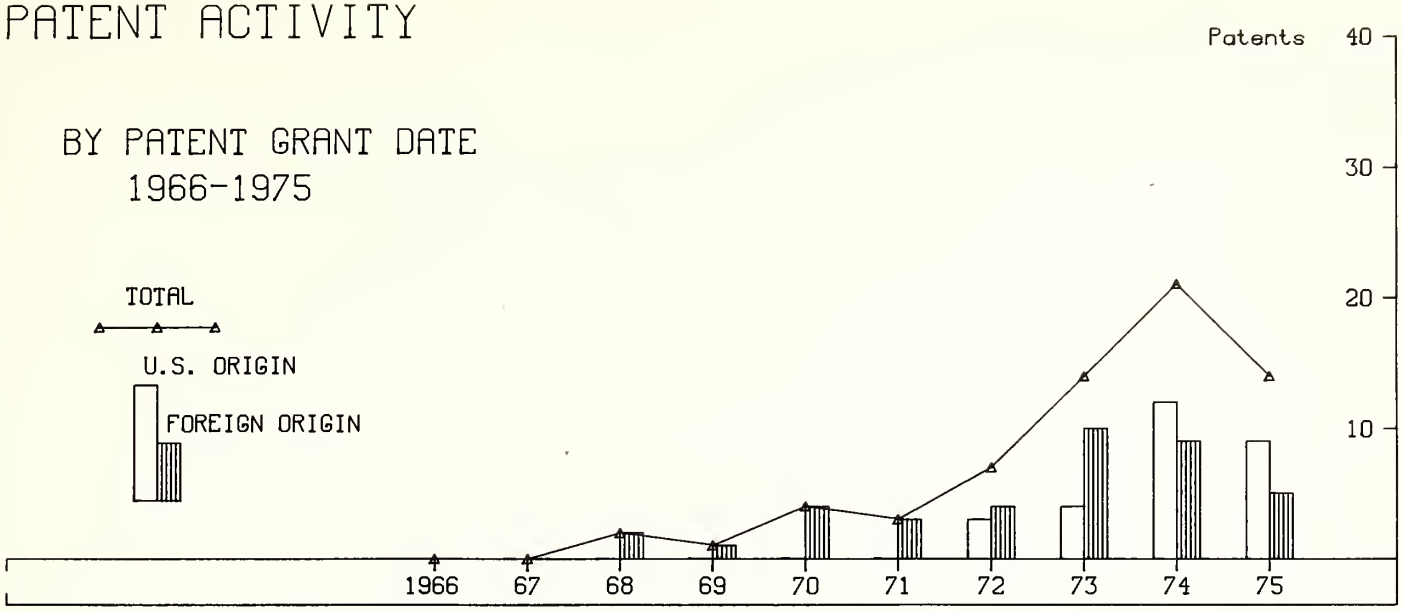
3,867,261 (Solano, Salem) - Volatiles and carbon particles are directed to a fuel incinerator, mixed with air or oxygen and combusted prior to their entry into the flue stack.

3,879,267 (Nashan et al, Germany) - A shed fitted over coke oven battery doors contains a dust and gas extraction system connected to a water scrubber for removing impurities from the air flow.

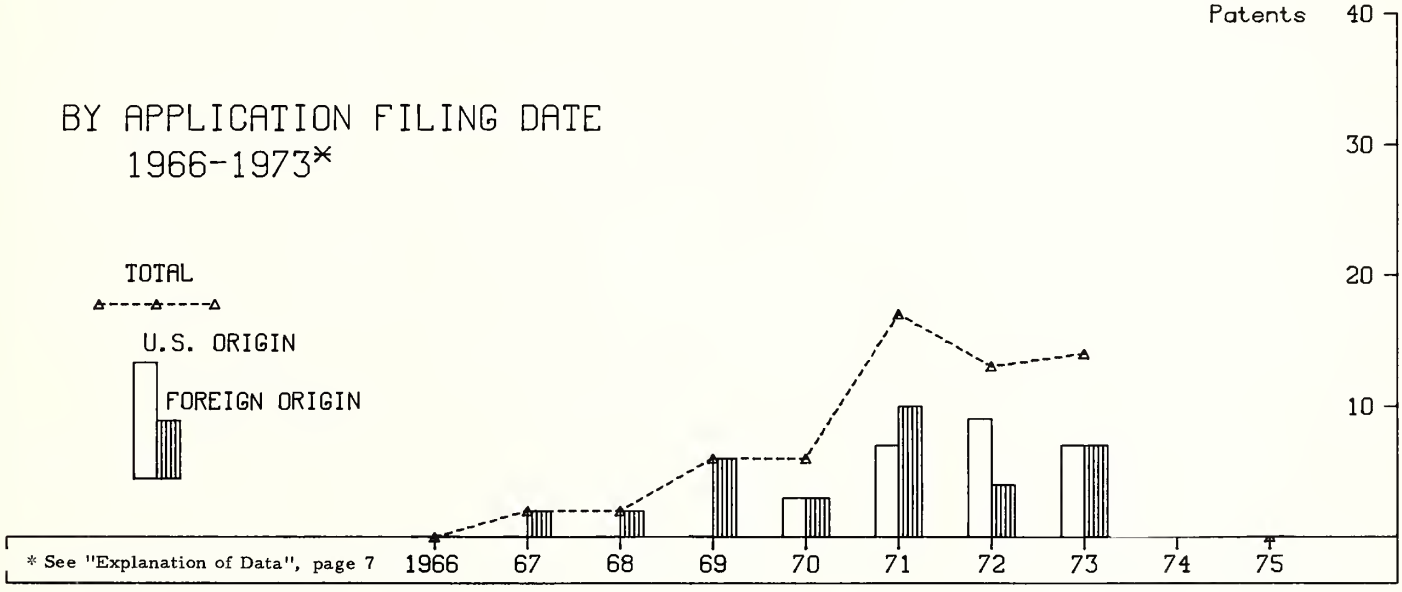
3,928,144 (Jakimowicz, National Steel) - Discloses a guide carriage with an exhaust hood having an open end facing the coke ovens which enshrouds the fuming coke as soon as it is discharged from the oven.

PATENT ACTIVITY

BY PATENT GRANT DATE
1966-1975



BY APPLICATION FILING DATE
1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS			2	1	4	3	7	14	21	14	66		2	2	6	6	17	13	14	60
UNITED STATES							3	4	12	9	28					3	7	9	7	26
TOTAL FOREIGN			2	1	4	3	4	10	9	5	38		2	2	6	3	10	4	7	34
GERMANY				1	3	3	4	8	8	2	29		1	2	6	3	8	3	5	28
JAPAN								2		1	3						2		1	3
FRANCE			2								2									
USSR					1					1	2		1						1	2
UNITED KINGDOM									1		1							1		1
CANADA										1	1									

BONE AND JOINT PROSTHESIS

Prostheses that replace broken or otherwise defective human or animal bone portions or joints such as stapes of the middle ear, and wrist, hip or knee joints. These may have both static and dynamic mechanical components, and usually are made of metal, hard plastic, or other resilient material. (Class 3, subclasses 1.9-1.913)

Average Annual Activity Indices (1973-75)

Growth	46.8%	Corporate Owned	49.4%
Foreign Share	55.8%	Government Owned	3.9%

Recent Activity

Recent activity in the field of bone and joint prostheses is directed to: increasing strength; improving corrosion resistance and biological compatibility for longer service life; reducing friction wear and internal stress buildup; increasing comfort to patient; reducing likelihood of dislocation; reducing time spent in surgery; and simplifying surgical procedures. The following patents, issued since June 1974, include:

3,820,167 (Sivash) - An artificial hip joint which uses an acetabulum prosthesis of the cotyloid cavity. A socket is employed which has a plurality of blades engaging the cavity wall. The prosthesis for the head of the femur consists of a hip ball, movably located within a socket, and anchored to the femur by a pin driven into the bone marrow.

3,843,975 (Tronzo) - A femoral shaft prosthesis having a ball and neck structure at one end and medullary stem at the other end. A head containing a threaded socket and outrigger knives connects the medullary stem and neck. A tool placed in the socket is struck with a hammer to drive the stem into the medullary cavity of the femur and the knives into the bone. Screws, attached to the head and femur, prevent rotation.

3,896,503 (Freeman et al, National Research Development Corporation) - An ankle joint prosthesis that replaces tibial and talar bone portions and consists of complementary concave and convex engaging surfaces. Gap-filling cement secures these bone replacements to excavated portions of the tibia and talus.

3,896,504 (Fischer) - A hip joint prosthesis consisting in part of a concave socket extending into a depression of the hip bone. A flange, anchored with screws, surrounds the socket and overlaps the bone adjacent to the depression. Expansion anchors inserted into the bone keep the concave socket in place as the flange screws are tightened.

3,896,505 (Timmermans) - A prosthesis for the femoral portion of a hip joint consisting of an artificial femoral head and a two-part, elbow-shaped, polyethylene support. Both the head and support contain an internal channel through which studs or nails are inserted to anchor these in position.

3,905,047 (Long, Posta Jr.) - Discloses a biodegradable bone prosthesis formed from molten material containing discrete particles of a refractory oxide dispersed throughout a eutectic mixture of a metallic pyrophosphate and the identical refractory oxide comprising the particles.

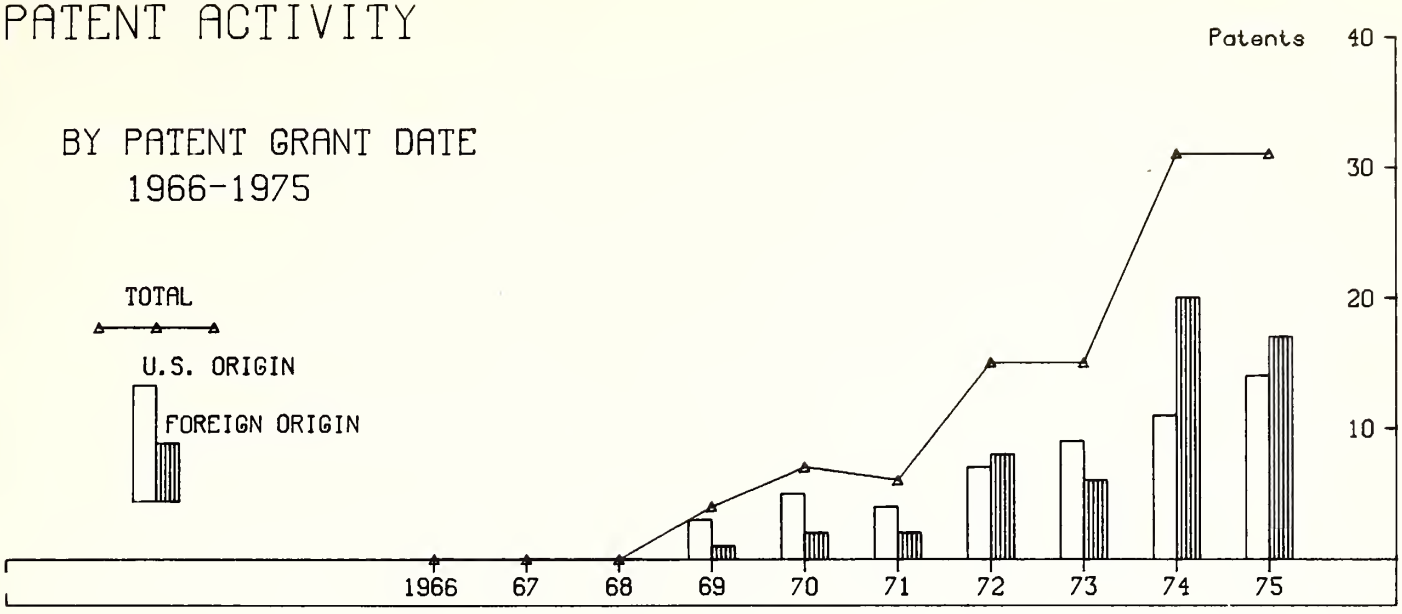
3,909,853 (Lennox, National Research Development Corp.) - Discloses a wrist joint prosthesis having a radial component, a carpal component and a plurality of metacarpal components. The radial component has a socket attached to a stem connected to the radius. The carpal component has a spherically shaped ball inserted in the socket and a slotted arcuate member attached to the ball. The metacarpal components each include a small spherical ball and attached stem for extension from the slotted member.

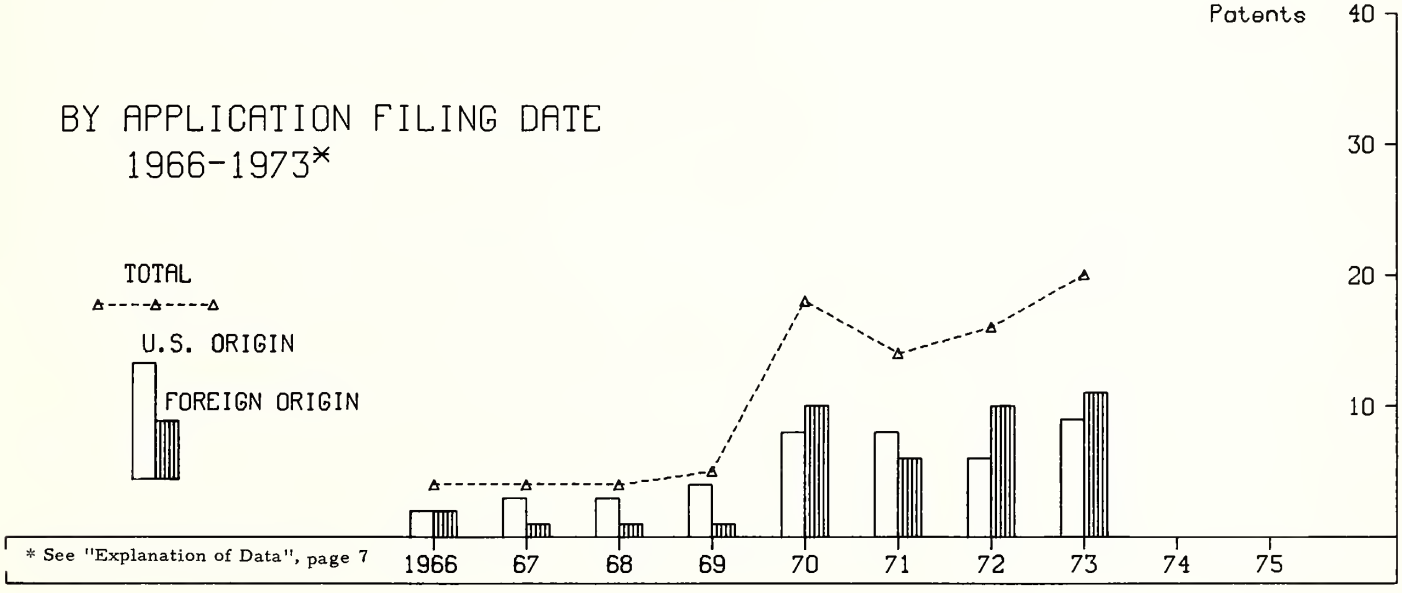
3,909,854 (Martinez) - A knee implant prosthesis which has the ability to rotate, abduct-adduct and flex. It consists of two, spaced, pivot bearings mounted in a pivot structure, connected to the femur and tibia bones via connector shields placed in surgically prepared cavities of the bones.

3,918,101 (Lagrange et al) - Discloses a prosthetic knee joint which has a metallic rocker that swings about a horizontal pin attached to a stem inserted into the tibia. The pin is secured in a two-part bearing of synthetic resins whose upper part is coupled to a shank that is placed in the femoral shaft.

3,931,648 (Shea, Jr., Richards Manufacturing Company) - A prosthesis for a defective stapes of the middle ear which consists of a piston-like element attached to a clamp anchored to the incus. The end of the piston-like element is adjacent the oval window of the middle ear and has an indent for allowing the membrane covering the oval window to grow thereinto for proper positioning.

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS				4	7	6	15	15	31	31	109	4	4	4	5	18	14	16	20	85
UNITED STATES				3	5	4	7	9	11	14	53	2	3	3	4	8	8	6	9	43
TOTAL FOREIGN				1	2	2	8	6	20	17	56	2	1	1	1	10	6	10	11	42
UNITED KINGDOM					1	1	3	2	6	7	20	1		1		4	1	5	2	14
GERMANY						1	1	3	4	7	16					4	1	1	5	11
SWITZERLAND					1		1		5	1	8		1		1		1	2	2	7
USSR									4		4						2		2	4
FRANCE							2		1	1	4					1	1	1		3
SOUTH AFRICA								1			1							1		1
ITALY										1	1									
CANADA							1				1					1				1
NORWAY				1							1	1								1

METAL CASTING UTILIZING ELECTRODES

Metal casting apparatus and methods which use an electrode to resistively heat a slag bath which in turn melts either the electrode or adjunct feed material (electroslag remelting). Also, apparatus and methods which use an electric arc for melting metallic work material or for melting a consumable electrode. Metallic ingots or other metallic forms (hollow pipes, slabs, etc.) are examples of products manufactured by the apparatus and methods found here. (Class 164, subclasses 52 and 252)

Average Annual Activity Indices (1973-75)

Growth	15.0%	Corporate Owned	58.8%
Foreign Share	81.4%	Government Owned	0.0%

Recent Activity

Recent efforts focus on electroslag remelting apparatus and processes which provide finished products of more precise detail, needing little if any machining; and, methods of combining pre-forms with the cast product in the same structure as that used for casting the product. Patents, issued since January 1973, include:

3,713,476 (Paton et al) - Disclose an electroslag consumable electrode remelting apparatus which prevents ingot cracking by decreasing heat loss. A mold is employed which retains a slag bath in the upper portion and the formed ingot in the lower portion. The electrode and bottom plate remain in fixed positions while the mold is moved upwardly with respect to the ingot during remelting.

3,804,148 (Schneidhofer) - Discloses application of heat insulating rings to exposed hot ingot surfaces as they exit the mold during an electroslag remelting process. These rings prevent tension cracks that occur during air cooling of the ingot or when cooled ingots are reheated.

3,804,149 (Medovar et al) - Discloses an electroslag remelting apparatus which produces metal structures having two identical elements connected by a link (e.g. H or barbell shape). The mold consists of two equal parts or halves, each operating with its own consumable electrode, joined together by a cavity which forms the link. A pair of vessels supply molten electrode metal through a common slag bath to the respectives mold halves.

3,804,150 (Paton et al) - Discloses an electroslag consumable electrode remelting apparatus which allows for injection of agents for cleansing and degassification of the ingot mold. The mold is provided with a nozzle through which the agents are blown.

3,848,657 (Tetjuev et al) - Discloses an electroslag remelting apparatus to make hollow ingots of constant wall thickness which uses a fixed hollow consumable electrode. The electrode inner walls are contacted with a set of rollers which are fixed-coupled to a vertically driven mandrel and electrically insulated from the mandrel.

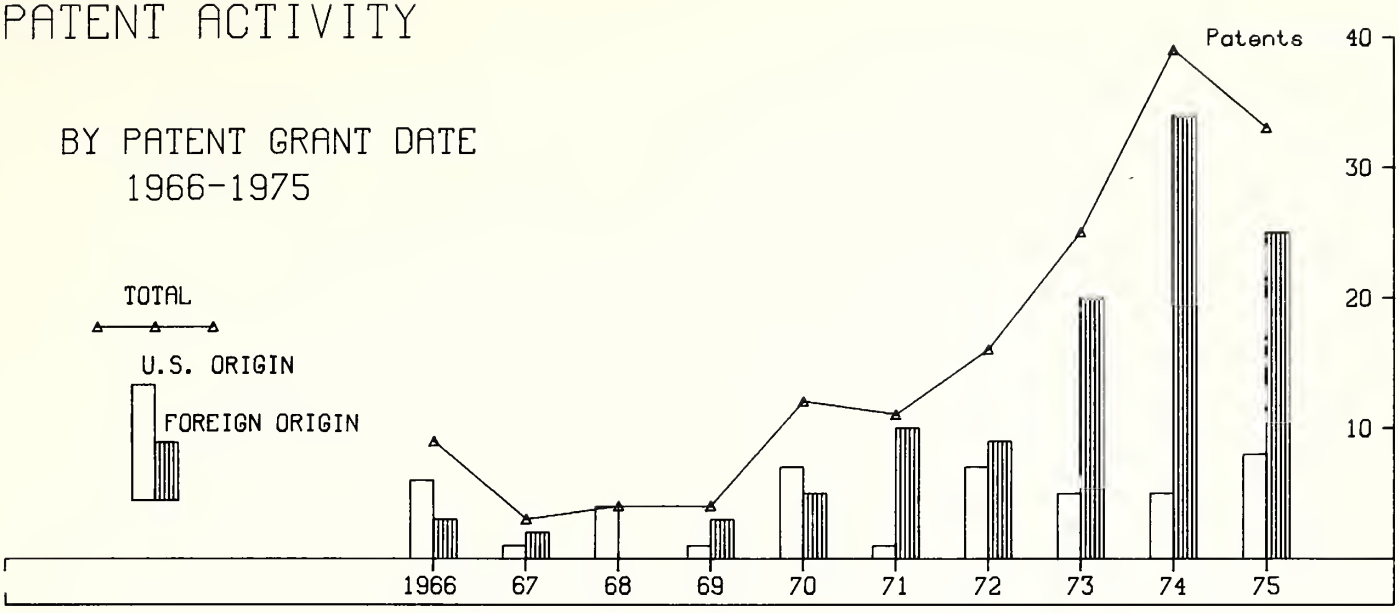
3,894,574 (Paton et al) - An electroslag consumable electrode apparatus and process to produce multi-component, complex-shaped metal articles. The main component of the finished article is cast in a mold. At the same time, other components are fused to this main component.

3,916,977 (Bakker et al, De Rotterdamsche Droogok Maatschappij B.V.) - An electroslag remelting apparatus which produces slabs of metal by welding together a series of beads formed from molten metal. A platform containing a reel of metallic wire and a molding shoe rides vertically along a post. Heating current melts the wire to form a welding bath in the shoe which is used to weld layers of molten metal beads onto previously welded solidified beads.

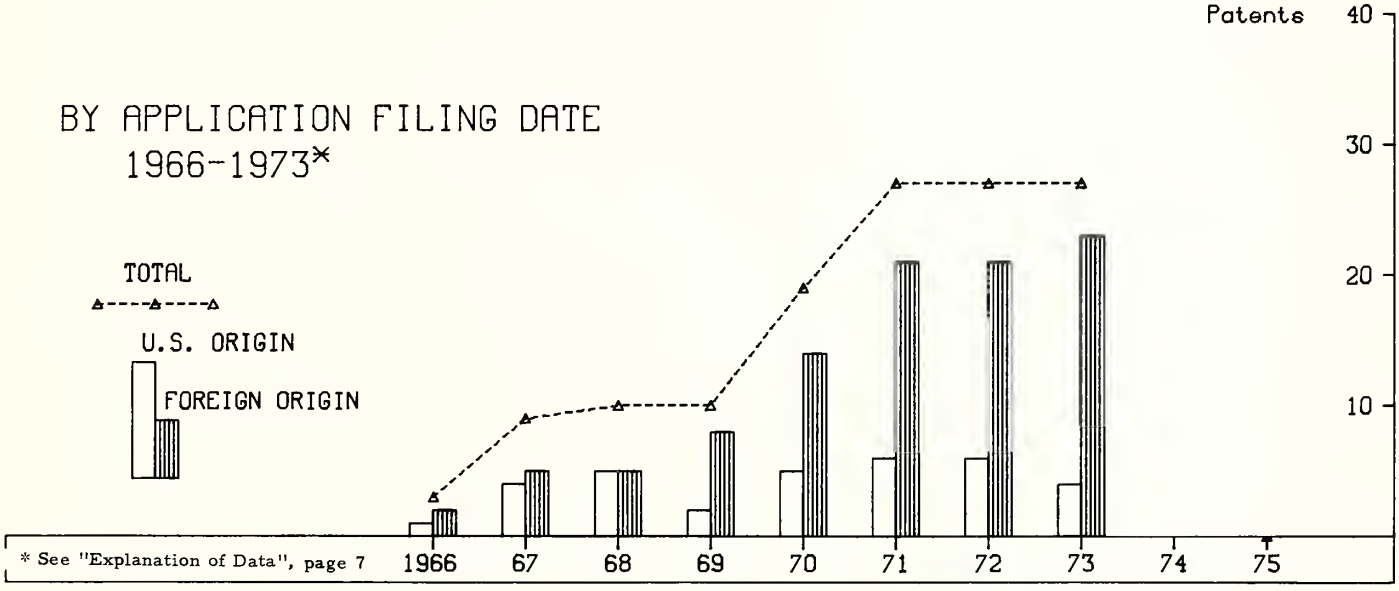
3,938,581 (Rabinovich et al) - Discloses an apparatus for providing hollow metal ingots with openings in their surfaces. A hollow consumable electrode is lowered between internal and external ingot shaping structures into a space containing a slag bath and melted. The openings are formed by mandrels introduced within longitudinally oriented electrode slots.

PATENT ACTIVITY

BY PATENT GRANT DATE 1966-1975



BY APPLICATION FILING DATE 1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	9	3	4	4	12	11	16	25	39	33	156	3	9	10	10	19	27	27	27	132
UNITED STATES	6	1	4	1	7	1	7	5	5	8	45	1	4	5	2	5	6	6	4	33
TOTAL FOREIGN	3	2		3	5	10	9	20	34	25	111	2	5	5	8	14	21	21	23	99
USSR					1	3	3	13	16	12	48		1		3	7	11	11	11	44
JAPAN						1	3	3	8	3	18		1			3	6	1	5	16
AUSTRIA				2	1	2	1	2	4	1	13	1	2	1	3	1	1	3	1	13
UNITED KINGDOM	1	1		1	1	2			3	2	11	1	1	3				3	2	10
GERMANY	1				2	1	1	1		3	9			1	2	1		2	1	7
FRANCE	1								1	1	3					1			1	2
AUSTRALIA							1		1		2						1	1		2
LUXEMBORG								1	1		2						2			2
NEW ZEALAND										1	1								1	1
ALL OTHER (4)		1				1				2	4					1			1	2

IRRIGATION TYPE FLUID DECELERATORS

Irrigation type devices which receive rapidly flowing fluid from a flow line into a chamber and slow this fluid by providing: (1) egress ports or escape routes of increased number and effective area as compared to the area of the fluid inlet; (2) an increase in at least a portion of the flow line or chamber; or, (3) a tortuous flow path in the flow line or chamber. (Class 239, subclass 542)

Average Annual Activity Indices (1973-75)

Growth	21.7%	Corporate Owned	35.4%
Foreign Share	24.6%	Government Owned	0.0%

Recent Activity

Recent activity centers on structures which prevent buildup of particulate matter in the decelerator; provide for a flush mode of operation to remove debris prior to use; or, compensate for variations in fluid pressure within the main flow line. Patents, issued since November 1973, include:

3,774,850 (Zeman) - A tube constructed of biodegradable polymer distributes water to plants through a series of openings along its length. Internal surfaces of the tube are secured adjacent each opening to define a labyrinth-like flow path for providing restrictive flow to water prior to reaching the opening.

3,777,987 (Allport) - Discloses an irrigation device having an outer pipe and inner tube, each of which has a series of holes along its length. The tube holes are offset from the pipe holes and the surface common to the tube and pipe is textured, creating a restrictive flow path to reduce the velocity of water flowing from the inner tube to outer pipe.

3,797,754 (Spencer) - Discloses a continuous tube trickle irrigator incorporating a series of self-flushing emitters which act as flush passages for particulate matter below a predetermined fluid pressure. At higher pressure, these emitters collapse to form minute passages for flow rate reduction.

3,810,582 (Lodge, Conflow Irrigation Systems) - An irrigation system which employs emitters with members that open for flushing to remove particulate matter. Water first enters a meter valve which causes turbulent flow leading to reduction of water pressure within the emitter, and then it is distributed to a plurality of outlets.

3,873,030 (Barragan) - Discloses a one piece drip irrigation device attached to a supply pipe which contains a sequence of right angle paths to drop fluid pressure.

3,874,596 (Baxter) - A fluid discharge device consisting of a riser coupled to a supply inlet that regulates the fluid pressure upon discharge. A tubular member mounted inside the riser has an adjustably mounted sleeve to regulate discharged fluid pressure in response to fluid pressure variations in the supply line.

3,874,597 (Stephens et al, Westates Space-Era Products Inc.) - Discloses an irrigator which utilizes a flexible conduit closed at one end and attached to a water supply at the other end. Pressure responsive valves and flow control devices are intermittently connected along the conduit length so that, as the conduit fills with water, successive sections become inflated and trickle flow occurs. When the water supply pressure is lowered, successive sections of the conduit deflate and close down.

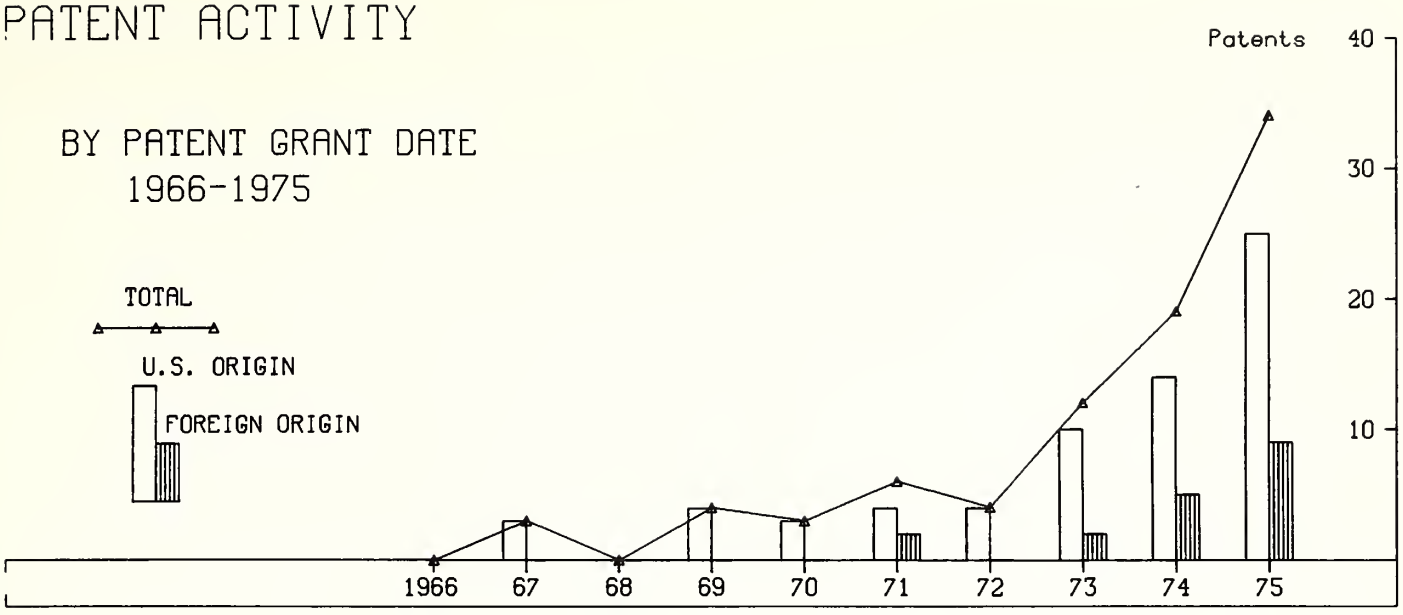
3,887,139 (Pearce, Illinois Tool Works Ltd.) - A trickle system emitter with upper and lower interlocking chamber halves containing a spiral formed of fine diameter tubing. The tubing is connected to either the inlet or outlet port of the chamber and provides friction to high pressure incoming water to reduce flow rate to a trickle.

3,897,009 (Rangel-Garza et al) - Trickle irrigation device with two members, one insertable within the other. The inner member contains spiral-like grooves which meet with the inner surface of the outer member to effect reduced pressure and trickle flow.

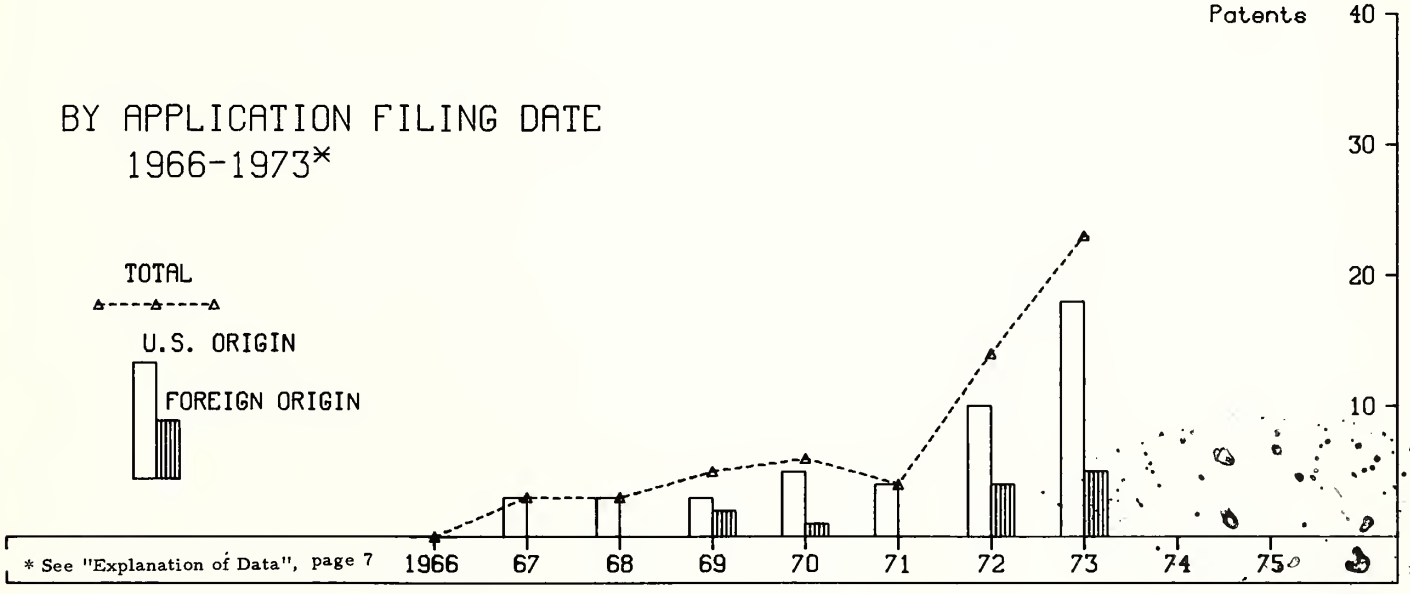
3,926,375 (Reeder et al) - Discloses a weeper irrigation device having a valve chamber containing two independent flow responsive members coupled to a support duct. When duct flow is initiated, one valve member acts to allow rapid flow for a short time to remove foreign matter and thereafter provides decelerated flow. When duct flow is stopped, the other valve member prevents foreign matter from entering the supply duct.

PATENT ACTIVITY

BY PATENT GRANT DATE 1966-1975



BY APPLICATION FILING DATE 1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS		3		4	3	6	4	12	19	34	85		3	3	5	6	4	14	23	58
UNITED STATES		3		4	3	4	4	10	14	25	67		3	3	3	5	4	10	18	46
TOTAL FOREIGN						2		2	5	9	18				2	1		4	5	12
MEXICO								1		5	6					1			2	3
ISRAEL						1			2	1	4				1				2	3
SOUTH AFRICA						1			1	1	3				1			1	1	3
FRANCE								1	1		2							2		2
AUSTRALIA									1	1	2							1		1
UNITED KINGDOM										1	1									

CHARGE TRANSFER DEVICES [a]

Introduction

The basic charge transfer device is a species of analogue shift register. It is a semiconductor device in which an applied electric field induces potential minima for signal charge packets at storage sites at or near the surface of the semiconductor material. The applied electric field is varied to shift the potential minima to adjacent storage sites so as to transfer signal charge within the semiconductor substrate from storage site to adjacent storage site in serial fashion.

Compact, rugged, all solid-state TV cameras and high density, low cost semiconductor memories are two diverse prospects, which may be realized by the development of charge transfer devices.

Patents to charge transfer devices first appear in 1971. Since then this technology has experienced an extremely rapid growth. In the period 1973-75 patent activity has been growing at an average annual rate of 159.4% which is about 69 times the average for all technologies combined. The graphs on the following page illustrate this growth by both patent grant date and the application filing date of these patents [b].

In terms of numbers of patents granted, the U.S. is the clear leader in this technology. Over the most recent three year period (1973-75), 17.8% of all patents in this area have been granted to foreign residents. This is about half the all technology foreign share average of about 33% for the same period. The country table which follows the graphs (next page) shows, both by patent date and by patent application date, the distribution of the patents that were found to have been granted in this field.

Thrust of the Technology

In the integrated MOS bucket brigade device [BBD] (1)[c], the storage sites are located within impurity doped regions (the "buckets") which form PN junctions with the surrounding substrate. In the charge coupled device [CCD] (2), as originally conceived, the storage sites were in a substrate of the same conductivity type with no doped regions. However, forms of CCD's now have doped regions (3,4) so that the difference between CCD and BBD is subtle. The difference is that in a BBD the regions are doped to a high enough impurity concentration that the device operates in "bucket brigade" or "incomplete charge transfer" mode rather than "complete charge transfer" mode which is the usual desired mode of operation in a CCD (5).

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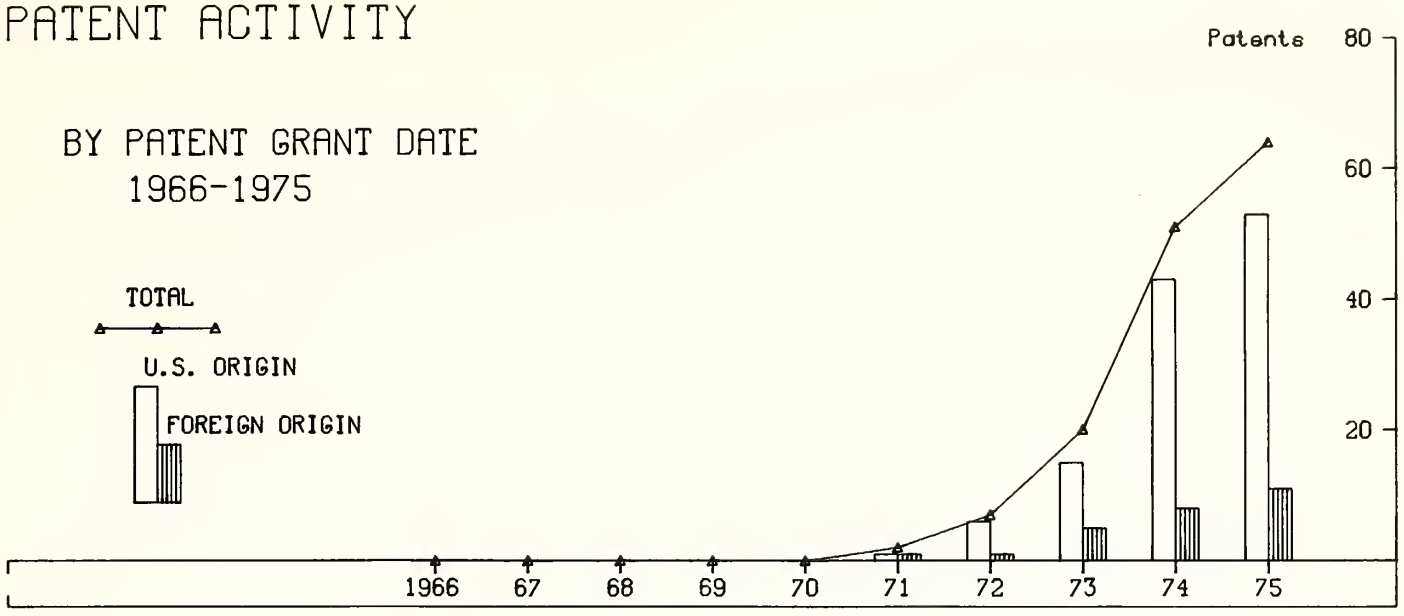
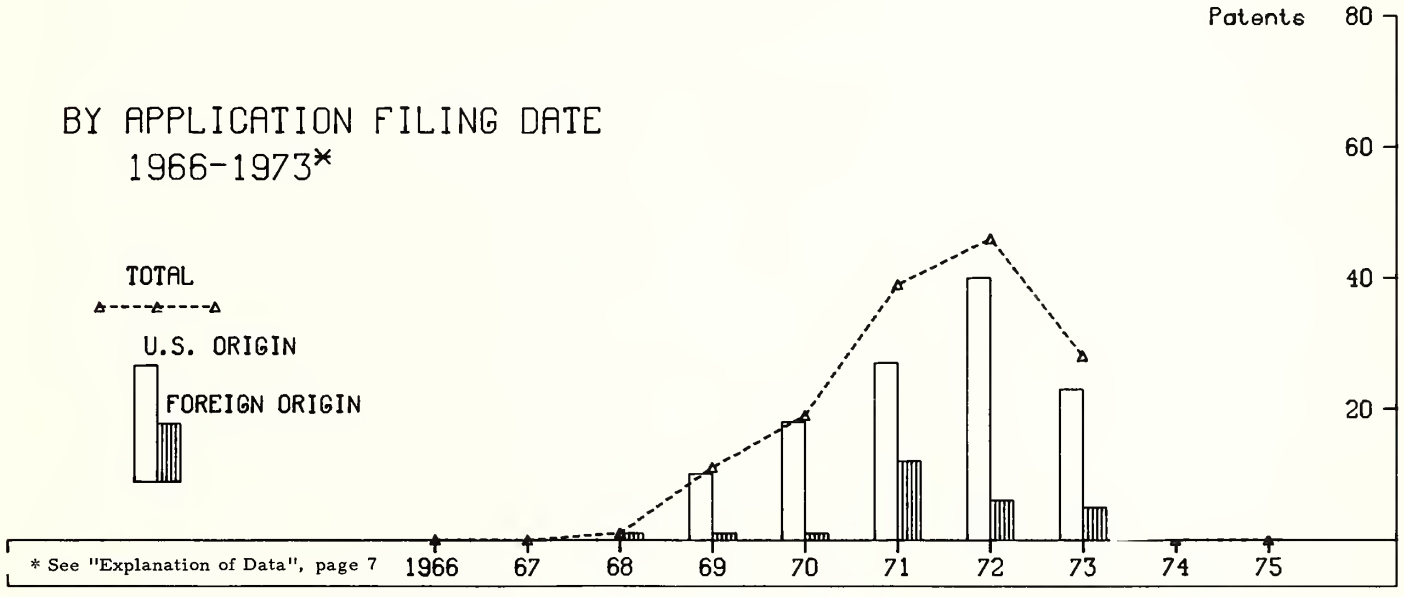
[a] The technology review in this report is mainly classified in U.S. Patent Classification System Classes 29, 148, 235, 250, 307, 333, 340, 357, and 358

[b] See "Explanation of Data", page 7

[c] Numbers in parenthesis refer to patents listed in the Bibliography

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS						2	7	20	51	64	144			1	11	19	39	46	28	144
UNITED STATES						1	6	15	43	53	118				10	18	27	40	23	118
TOTAL FOREIGN						1	1	5	8	11	26			1	1	1	12	6	5	26
JAPAN								1	5	3	9						6	1	2	9
NETHERLANDS						1	1	3	2	1	8			1	1	1	3	2		8
GERMANY										3	3								3	3
UNITED KINGDOM										2	2							2		2
CANADA								1		1	2						2			2
FRANCE									1	1	2						1	1		2

In charge transfer devices the electric field is generally supplied by clock potentials of different phase applied to discrete electrodes. Two-phase devices have electrodes in groups of two with alternate electrodes connected to the same phase clock line, similarly for three-phase and four-phase devices. Two, three and four electrode groups constitute one storage element or one bit of information in two-, three- and four-phase devices, respectively.

The charge transfer device has promise 1/ because it can be used for analogue signal processing and 2/ because each storage element can be made of relatively small size (e.g. less than .01 cm square) with low power consumption and, hopefully, low cost/bit. Present possible uses are cameras and light sensors (6, 7), displays (8), delay lines (9), memories (10, 11), charge amplifiers (12), A-D and D-A converters (13), transversal filters (14, 15) and correlators (16).

Development in this technology has been directed towards modification of the basic charge transfer device and to methods of fabrication, as well as to applications.

A basic problem encountered has been the less than 100% transfer of a signal charge packet from storage site to storage site. This transfer inefficiency increases at frequencies of operation above 1MHz. Even if the transfer inefficiency is one part in 10 , one hundred transfers would mean 10% of a leading signal charge packet would be dispersed over following charge packets with resultant degradation of signal discrimination.

Since the relative transfer inefficiency decreases for larger signal charge packets, one solution is to use a constant background charge or "fat zero" (17). In addition, four-phase operation is more efficient than two-or three-phase but more complicated with respect to providing feedlines for clock signals. Also the signal can be regenerated after a set of transfers, particularly in serial memories using binary signals (18).

A major development has been to transfer the signal charge .5 m or more from the semiconductor surface, by use of repulsive clock potentials, in bulk channel CCD's (19, 20) rather than at the surface interface, by use of attractive clock potentials, as in surface channel CCD's. Using bulk channel CCD's, ransfer inefficiencies of less than one part in 10 at frequencies of over 10 MHz have been obtained (21).

Gate electrode structures in charge transfer devices are directed towards small size with few processing steps. Structures used are single metal layer (1), multilevel metal (22-24), overlapping metal and polycrystalline silicon (18, 25), overlapping aluminum-anodized aluminum (25, 26), single level polycrystalline silicon (27, 28) and multilevel polycrystalline silicon (29). Transparent silicon gate electrodes have particular use in image sensor applications.

Two-phase devices need a built-in asymmetric surface potential, to provide a transfer direction, which can be achieved by oxide thickness (22), implanted charge in oxide (30) and doped regions in the semiconductor substrate (3). Each two-phase electrode structure then has a transfer part and a storage part. A variation of two-phase operation is to apply separate two-phase clocks to the storage part and to the transfer part, four clocks in all, for more control over the transfer process (31).

Image sensors used can be line sensors (32) or area sensors which use frame transfer (33) and interline transfer (34). A particular problem in sensors is exce-s charge at a storage site which needs to be removed so the charge does not spread into adjacent storage sites ("blooming") (6, 7, 35).

Serial charge transfer device memories can use serpentine (18, 36) and serial-parallel-series (37) architecture. Charge transfer devices can also be used for read only memories (38). The technology of random access memories, in which a single charge transfer is made between a storage location and an impurity doped sense line (39), is related to charge transfer devices as well as to random access MOSFET memories. However, this technology is not covered in this report.

Up to now practical use of charge transfer devices has been tentative, but commercial use for imaging is emerging. Fairchild, for example, currently sells a line sensor [CCD 110] and an area sensor [CCD 201], both using bulk channel CCD's. Visible light video TV cameras and military infrared cameras should be common within a few years. The major problem is obtaining a quality image. Transfer inefficiency degrades spatial resolution; and dark current and "blooming" are problems.

Commercial use of charge transfer device serial memories also is likely to be soon. The major problem here is cost per bit of stored information. Work on charge transfer devices for transversal filters, Fourier Transforms, correlators and other signal processing is active. Practical use of charge transfer devices in analogue signal processing in general appears to be just at the opening stage.

Technology Analysis by

Gene M. Munson
Patent Examiner

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SURFACE ACOUSTIC WAVE DEVICES [a]

Introduction

This technology is directed to signal processing techniques wherein electrical signals are converted to surface acoustic waves.

The trend towards miniturization of electronic circuits has been continually implemented by advances in semiconductive devices and printed and integrated circuit technology. Evidence of such miniturization is to be found in nearly all electronic applications, including television and F.M. broadcast receivers, radar systems for navigation and military applications and communication receivers.

However, miniturization to some extent, has been limited by the fact that frequency selective structures (tuners, filters, noise reduction networks), essential to electronic circuit applications, require either relatively bulky "lumped" circuit elements at the lower frequencies, or space consuming waveguide elements at the higher frequencies. The development of compact, light weight, planer, surface acoustic wave filter components, as substitutes for these bulky "lumped" circuit elements and waveguide structures, augments the advances in miniturization and weight reduction provided by semiconductor devices, printed circuitry and integrated structures.

It is interesting to note that the planer processing techniques and photolithographic procedures used in integrated and printed circuit structures permit the fabrication of surface acoustic wave devices. As a result, a high degree of compatibility exists both in the format of integrated circuit structures and surface acoustic surface wave structures and in the manufacturing processes for such structures. The ability to economically mass produce integrated circuitry thus finds a counterpart in the production of surface acoustic wave devices.

Surface acoustic wave devices operate by converting electrical energy to surface acoustic waves. These surface acoustic waves may then be reconverted to electrical energy or caused to interact with optical waves to produce optical wave deflection (scanning) or modulation. The transduction of electrical energy to acoustic wave energy and visa versa is accomplished by phase and frequency sensitive interdigitated comb structures coacting with a substrate having piezoelectric properties. Since the propagation of acoustical waves is accompanied by mechanical deformation of the substrate, the optical transmission characteristics of the substrate vary, thus providing opportunities for deflecting or modulating light energy.

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[a] The technology described in this report is contained primarily in Patent Classification System Class 333, subclasses 30 and 72; and, Class 310, subclasses 8 through 9.8.

The first patents to surface acoustic wave devices appeared in the late 1960's, and growth in the technology began rapidly to accelerate in the early 1970's. Since January 1973, patent activity in this area has been growing at an average annual rate of 43.4% or about 19 times the average of 2.3% for all technologies combined. This patenting activity and growth is illustrated in the graphs on the next page; first by patent date and then by the application date of patents granted since 1967[b].

As can be seen from the graph, the U.S. has been the clear leader in the development of this technology. However, in recent years the number of U.S. patents in the technology granted to residents of foreign countries has risen sharply, averaging in the last three years, 29% which is approaching the all technology average of 33%. The country table which follows the graphs (next page) shows the distribution of patents in this field both by patent date and application date of patents granted since January 1967.

Thrust of Technology

Delay lines and filters employing bulk acoustic waves date back to the 1920's, and bulk wave structures have been a source of interest to the present time.

Surface acoustic waves were originally discovered in the 1880's by Rayleigh during investigations of geophysical disturbances. However, the use of surface wave phenomena as a tool for electrical signal processing was not actively considered till the mid 1960's as evidenced by the patents to Mayo (Pat. No. 3,376,572), Sittig (Pat. No. 3,360,749) and Tournois (Pat. No. 3,353,120).

In contrast to acoustic bulk wave media, acoustic surface wave structures provide opportunities for ready access to positions along an acoustic propagation path thereby enabling the realization of tapped delay line and filter structures. Such tapped structures provide for the realization of transversal filter functions useful in equalizer, frequency channeling, multiplexing, correction, convolution, coding, synthesizer and non-linear mixing applications.

Acoustic structures, and more particularly surface wave acoustic structures, are especially attractive since they provide for the realization of miniature, lightweight, signal processing systems. The velocity of propagation for acoustical signal energy is five orders of magnitude slower

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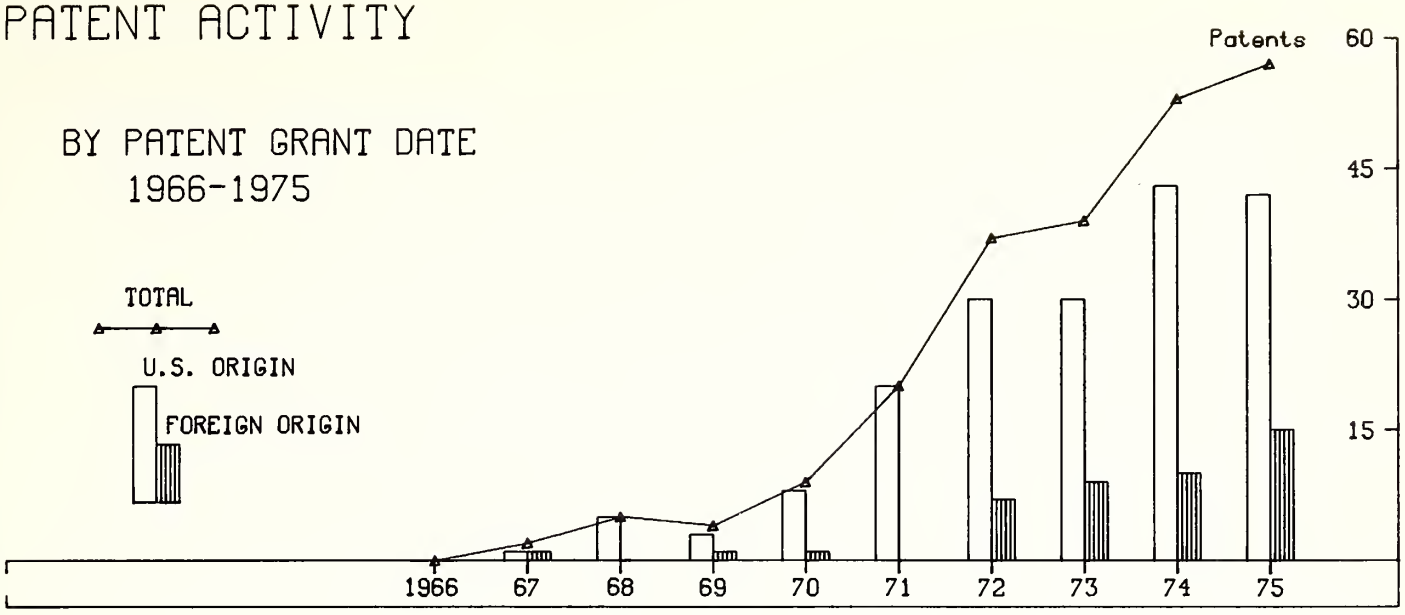
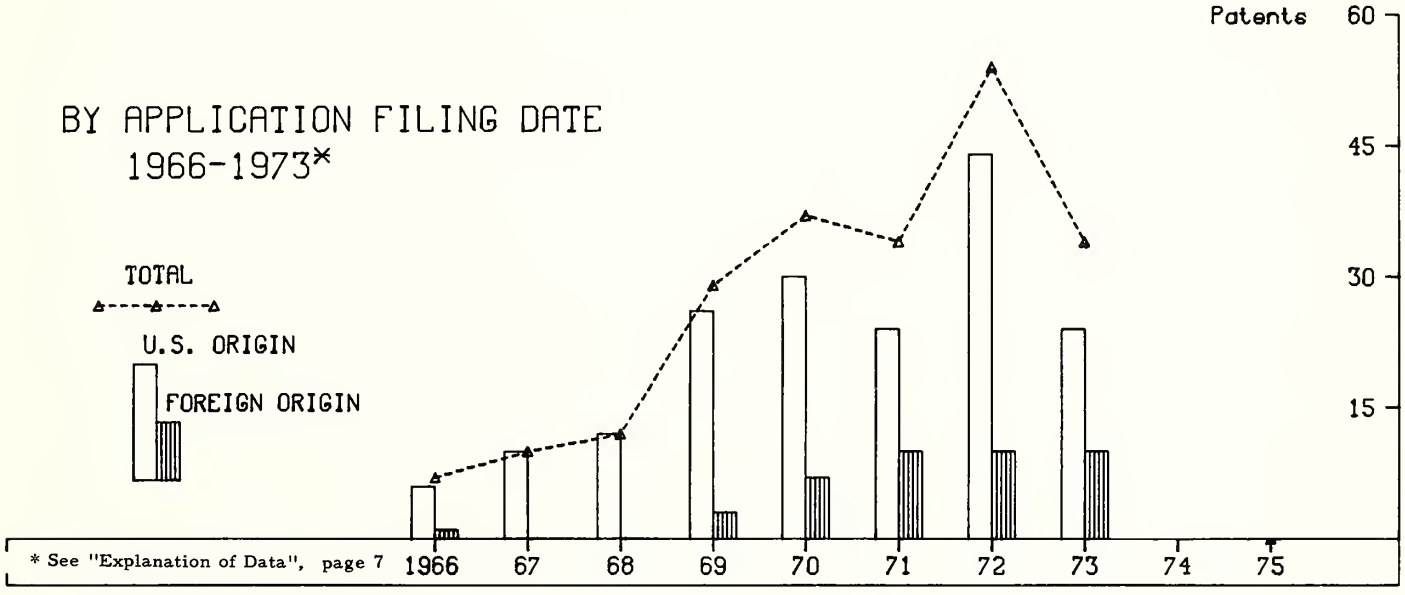
[b] See "Explanation of Data", page 7

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS		2	5	4	9	20	37	39	53	57	226	7	10	12	29	37	34	54	34	217
UNITED STATES		1	5	3	8	20	30	30	43	42	182	6	10	12	26	30	24	44	24	176
TOTAL FOREIGN		1		1	1		7	9	10	15	44	1			3	7	10	10	10	41
FRANCE		1		1	1		2	1	4	7	17	1			1	1	3	4	5	15
UNITED KINGDOM							3	4	2	6	15					4	4	3	4	15
GERMANY							1	4	1		6				1	2	2	1		6
JAPAN									1	2	3							1	1	2
AUSTRIA									2		2						1	1		2
POLAND							1				1				1					1

than that for electromagnetic signal energy. As a result, the distributed and iterative periodic structures useful for delaying and filtering application, although requiring dimensional extents approaching and sometimes exceeding the wavelength of the energy to be processed, can be realized in compact form. (This becomes apparent when it is noted that the wavelength of a signal of a given frequency is inversely proportional to the velocity of propagation.)

Basic to the realization of specific transfer functions needed in signal processing applications, are the configurations of the interdigitated electrode transducers used to launch and detect acoustic surface waves. The length, spacing, and overlap of the electrodes are determinative of the transfer functions which are realized (1-4) [c].

The interest in surface wave acoustic structures for fixed and variable frequency filter functions in TV and FM applications gained momentum soon after the development of the above referenced surface wave structures. Fixed frequency filters have found application in IF strips (6-7) while the development of tunable filters (16-19) shows promise for the realization of compact tunable "front ends" for TV, IF, and communication receivers.

As a result of their bi-directional transmission properties, interdigital transducers are prone to introduce spurious signals, delayed in time (ghosts). Typical of structures designed to eliminate or mitigate such spurious responses are the works of DeVries, Wojcik, and Dias (5, 6, 8). Continued development of structures directed to the reduction of spurious responses are typified by the contributions of Vasile, Moore, Hartmann, Jones and Adler (9-11, 13-15). The techniques for the reduction of spurious response include modification of basic transducer design (7, 13, 14, 15, 48), multi-phase transducer excitation (8, 9), reflected wave cancellation (8) and the use of acoustic absorbers (5).

The reduction of transmission characteristic variation with temperature has been a fairly recent subject of investigation. The choice of specific substrate material, the adjustment of acoustic path direction with respect to crystallographic substrate axes and the use of overlay materials have been investigated with respect to mitigating temperature dependent effects (53-58).

Since compact acoustic surface wave devices require relatively close spacing between transducers, the desired acoustic coupling between transducers may be acompanied by undesired electrical coupling. This problem has been mitigated by resort to electrode shielding, the use of auxiliary electrodes to provide cancellation, and combinations thereof (49, 50, 52).

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[c] Numbers in parentheses refer to patents listed in the bibliography in Appendix A

Compact acoustic surface wave devices requiring signal amplification as well as filtering and/or delay attributes were made possible by the development of propagating substrates exhibiting simiconductive as well as piezoelectric properties. Typical progress in the implementation of such devices is to be found in references 20-27.

The development of structures for splitting acoustic beam paths developed by Marshall and Page opened up possibilities for diverse multichannel signal processing functions (28). Additional developments in this area are reflected in the recent patents to Solie and Mayerfeld (28-30).

The application of acoustic surface wave devices to optical processing has been of continued interest. The scanning of optical images is typified by the patents to Quate et al and Lean (31, 32). Light modulation techniques are disclosed in the patents to Byram and Schmidt (33, 34).

Additional application of acoustic surface techniques to light processing are to be found in the patents referenced under items 35-43.

Application of surface acoustic wave devices to medical electronics is suggested by the patent to Harris (59). As disclosed therein, energy is directed into an object under observation. Spatial variations in the transmissive properties of the object reflect energy in various degrees, thereby permitting the formation of an image of the reflecting object.

The use of acoustic surface waves for rotation rate sensing is disclosed by Newburgh et al (60).

Future Trends

The characteristics of surface acoustic wave devices render obvious numerous applications which portend development trends. For example:

Light weight equipment to provide aircraft with long range navigational data and short range high resolution landing information is augmented by the pulse compression capabilities of surface acoustic wave devices. Pulse compression techniques allow for the reduction of transmitted power by a factor of thirty. As a result, transmitter power requirements can be met by using relatively low power, high reliability solid state circuitry. As a result of high reliability, periodic maintenance requirements are reduced and the transmitter can be located at the antenna rather than at more accesible but remote locations. As a result, the losses inherent in the use of long transmission lines are also eliminated.

The ability of acoustic surface wave devices to modulate and deflect light beams are indicative of future realization of large screen, high brightness, TV displays.

New techniques in acoustic wave probing for non-destructive flow detection in machine parts, utilizing surface acoustic waves show future promise.

The realization of high density information storage devices are portended by the development of devices utilizing circulation surface acoustic waves. Circulation provides for the realization of large delay times in a relatively small volume. Bandwidth is inherently limited only by transducer design. As a result, a large delay time bandwidth product (a direct measure of storage capacity) can be achieved.

Technology Analysis by

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ALGICIDES [a]

Introduction

Algicides are chemicals which kill or control the economically and agronomically important pests of the plant kingdom known collectively as algae.

Algae are chlorophyll-bearing organisms (and their colorless relatives) which are thalloid, i.e., "having no true roots stems and leaves or leaf-like organs." So varied are the plants comprising what are commonly called algae that a precise definition is difficult. The algae vary in size from unicells, 0.5 micron in diameter, to the huge seaweeds which may be upwards of 100 feet or more in length.

These pests owe their importance in part to the fact that they are ubiquitous. Although the algae are highly selective of particular habitats and are known to require specific chemical and physical conditions, their disjunct distribution is accomplished by air currents, migrating birds and aquatic animals.

As in the case of most chlorophyll containing plants, light and temperature are important factors in the alga ecology. Although algae are most commonly thought to occur in aqueous media, some exist well when surrounded only by a film of water and occur on and under the soil; others occur on sandy beaches, forming a dense green stratum just beneath the surface. Some species are limited to fresh water, some to salt water, others to brackish water and still other species are known to adapt to both fresh and salt water environments.

Certain of the algae, such as seaweeds and diatomaceous earth, have desirable qualities and may serve as food for man and fish, raw materials for medical products and commercial products. However, the patents in this class and subclass are concerned with the elimination of those species which are undesirable per se, or which cause undesirable effects to occur.

Among the undesirable manifestations of the algae are the following:

- Domestic and industrial water spoilage;
- Ruination of recreational sites;
- Interference in the pulp and paper industry via slime formation;
- Clogging of irrigation ditches and various water filtering devices;
- Usurption of available oxygen in aqueous media, causing suffocation of other life forms, such as fish;

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[a] The technology reviewed in this report is encompassed in U.S. Patent Classification System Class 71, subclass 67

- Secretion of certain toxins into the water which can cause death to man, animals and fish; and,

- Direct or indirect responsibility for certain human ailments such as skin allergies, pulmonary disease and digestive complaints, and certain parasitic effects on higher plants such as tea, citrus and bananas.

The commercial significance associated with achieving control of the undesirable forms of algae is manifest. Consequently, a large effort has been expended to develop new algicides and this effort is reflected in the recent patent activity in the technology. Over the most recent three year period (1973-75), this area has been growing at an average annual rate of 17.3% which is about 7 times the average for all technologies. The graphs on the following page illustrates this growth first by patent date, and then by application date of patents issued since January, 1967[b].

The foreign activity, evidenced by recent patent activity, is relatively low. Since 1972, the foreign share of the patent activity (U.S. patents granted to residents of foreign countries) has amounted to 15.0% which is less than half the all technology average of 33%. The foreign activity is shown in the country table (next page) both by patent date and by application date for patents issued since January, 1967.

Thrust Of The Technology

Almost every conceivable group of chemicals has been used to control algae. For the sake of symplicity and expediency these will be grouped and discussed in this report as follows:

- Heavy metal salts and derivatives

- Halogen-releasing agents

- Amines and "onium" salts

- Ureas and cyclized relatives

- Miscellaneous

- Mixtures

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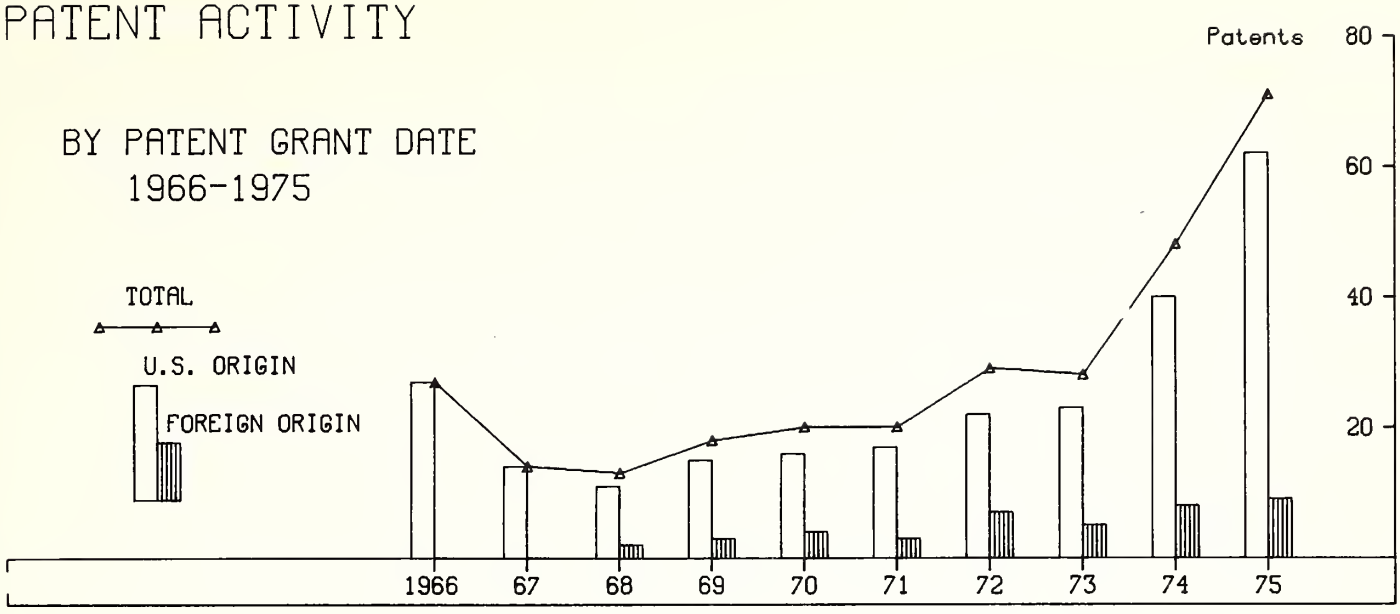
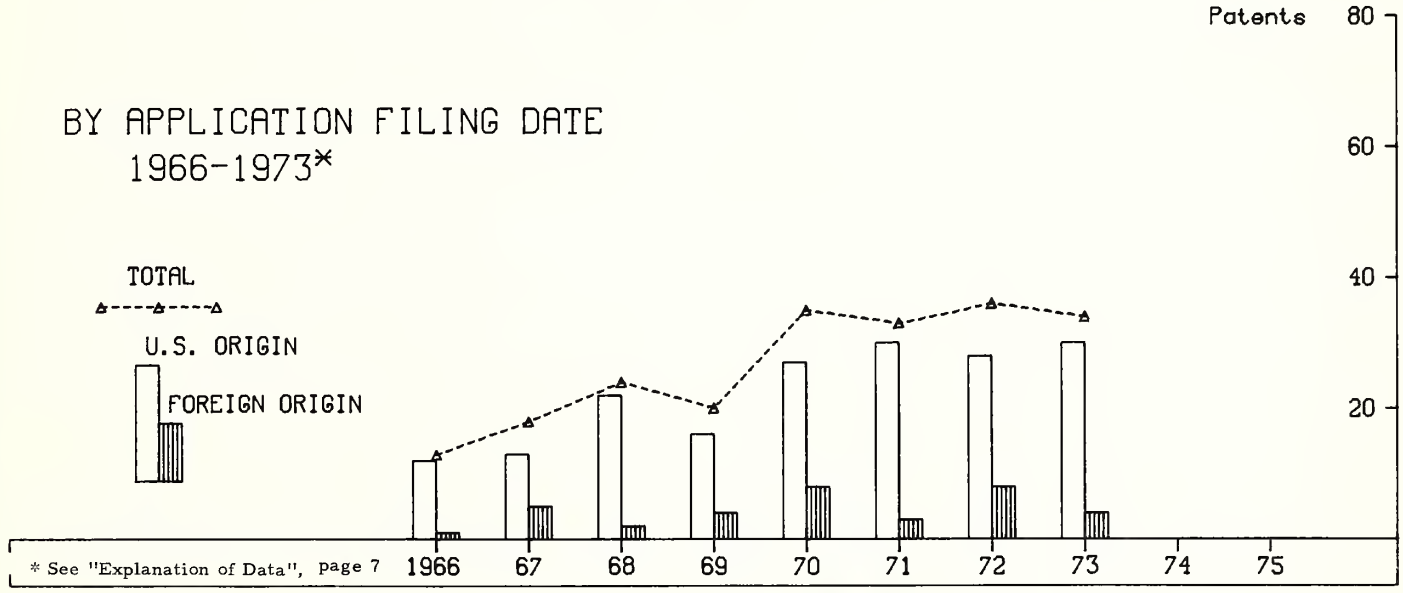
[b] See "Explanation of Data", page 7

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	27	14	13	18	20	20	29	28	48	71	288	13	18	24	20	35	33	36	34	213
UNITED STATES	27	14	11	15	16	17	22	23	40	62	247	12	13	22	16	27	30	28	30	178
TOTAL FOREIGN			2	3	4	3	7	5	8	9	41	1	5	2	4	8	3	8	4	35
GERMANY				1	4	2	5	1	4	3	20		4	2	3	3	1	2	3	18
SWITZERLAND				1			2	1	2		6		1			3		2		6
UNITED KINGDOM						1		2	1	1	5				1	1	1	2		5
CANADA			2							1	3							1		1
JAPAN								1	2		3						1			1
FRANCE								1		1	2					1			1	2
FINLAND										1	1							1		1
BELGIUM				1							1	1								1

Heavy Metal Salts And Derivatives

Although the exact date of its first use as an algicide remains obscure, copper sulfate continues to be one of the most effective and economical algicides available. This material, however, suffers from the problems of instability in some types of hard water and toxicity to fish and certain crops. Thus, its use is limited in those respects. In order to retain the biocidal properties of copper ions, certain derivatives were made and found active. These included such compounds as copper naphthenates, hydrazinium derivatives, methanarsonates, benzimidazoles and phosphorinanes (37, 12, 13, 22)[c].

In order to provide stability, the copper salts were mixed with hydroxy-containing acids (4). Other inventors formed complexes with such materials as sodium tetzaphosphate, alkanolamines and fatty polyamines (6, 8, 9). Copper ions were also added to copolymers; the latter serving as stabilizers and carriers for the active ingredient (18).

Derivatives of other metals were also employed, presumably, because of the inherent toxicity of copper ions. For example, organotin oxides, salts (esters) and solubilized derivatives were found to be effective (10, 14, 17), as well as tetra-substituted tin compounds (20). In 1973, organotin-substituted triazines were found to possess algicidal properties (21).

The organomercurials likewise received much attention as algicidal agents. Among the more important members of this series are phenylmercuric acetate, mercuric oxide or amide derivatives and quaternary ammonium salts of mercury-containing organic acids (2, 5, 19). Likewise, derivatives of arsenic were found to be effective algicides. Examples of these materials are arsenosobenzene and arsinyl xanthate derivateves (11, 15, 16).

Halogen-Releasing Agents

The use of chlorine gas as a slime (algae) control measure was an early development (23). Since then many halogen precusors and derivatives have been developed. Such halogen-precursors as chloramines, bromine chloride, chlorous acid ($HClO_2$) and hypoiodous acid (HIO) were found to be useful (24-27). The latter material is particularly useful since HIO is a combined germicide and algicide which has none of the undesirable side-effects encountered with previously known purification techniques including chlorination and iodination processes. It is particularly useful in

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[c] Numbers in parenthesis refer to patents listed in the bibliography at the end of this report

swimming pool water where the treated media is less irritating to the eyes and mucous membranes, less likely to bleach swimsuits and hair and retains its clarity for longer periods of time. The (HIO) molecules are usually formed in situ by the action of 1, 3-dichloromethylhydantoin on water-soluble iodide salts.

Elemental bromine also provides excellent microbiological control. In 1967, a process for treating water with elemental bromine was developed wherein the bromine is released from an insoluble quaternary ammonium anion exchange resin (28). The release of elemental bromine (Br_2) in this fashion provided for a safe and practical means of utilizing an otherwise extremely hazardous and corrosive chemical.

Amines And "Onium" Salts

Amines were developed because copper salts and chlorine-releasing agents have inherent limitations. Copper salts possess too narrow a microbiological spectrum (poor bactericidal activity), while chlorine-releasing agents are too easily dissipated under conditions favorable to the growth of algae.

Very effective amine compositions not so limited were discovered in the form of soluble acid salts or insoluble materials which were dispersed as emulsions to the situs to be treated (29, 30). The configuration of the algicidal amines varies from those containing a fatty aliphatic radical and a nitro substituent to aromatic amines including those containing the herbicidal phenoxy moiety (36, 39, 41, 43). Several interesting amine derivatives are those containing the imino ($\geq C=N-$) structure (33, 38, 42, 45). Dodecylguamidine acetate (33) is the commercial apple scab fungicide known as Cyprex™.

Quarternary ammonium salts would be expected to be active as algicides since they are, for the most part, water soluble and possess surface active properties. It is well known to the microbiologist that a microorganism is indeed susceptible (at least in aqueous media) to a material which lowers the surface tension outside the cell wall. If the external surface tension is sufficiently lowered, the osmotic pressure within the cell becomes great enough to burst the cell wall, resulting in death of the cell. Such materials as benzyl trimethylammonium naphthenate, n-dodecyltrimethylammonium xanthate, ixoquinolium salts as well as polymeric quat salts have shown this activity (31, 32, 34, 44).

The other members of the "onium" salts to be considered include the phosphonium salts (35, 37, 40). These materials are unique in their activity since not only are they selective to plant tissue with little other biocidal activity but they are also anticorrosives. Thus, these materials would be ideally suited for selectively controlling algae in aqueous systems.

Ureas And Cyclized Relatives

Ureas have had a tremendous impact on the pesticide field and no discussion relative to the latter would be complete without including these materials.

In 1957, phenylureas having a hydroxy or mercapto group attached to the phenyl ring were found to be effective algicides (46). These materials may be applied in the form of alkali metal (soluble) salts and may contain a nitro substituent attached to the phenyl ring. Shortly thereafter, similar phenylureas were prepared and found active as algicides (47). These materials possessed a perchloryl (ClO_3) group attached to the phenyl ring and, as one would expect, proved to be strong oxidizing agents capable of bleaching the algae and inhibiting further growth. When applied to higher plants these materials caused albinism and slow death in the treated plants.

Another interesting group of urea derivatives useful as algicides are those developed by Chevron Research (50, 53, 54). These materials are carbonyl unique in that they contain a thiohydroxamate (-CONHS-) linkage. More recently, a urea was patented which contains a CF_3-phenyl and a 3, 5-di CN phenyl substituent on the 1 and 3 nitrogen positions (55).

Certain uracils (49, 52), cyanuric acid (48) and barbituric acid derivatives (51) have also been found useful. The latter compounds are particularly interesting in possessing a wide spectrum of activity at very low application rates. Commonly referred to as violuric acid derivatives, they not only are good bactericides and fungicides, but very effective algicides as well.

Miscellaneous

In addition to the above mentioned materials, certain other structures have been found very useful as algicidal materials. Among these are esters (58, 72, 82), thioesters (84), phosphorous esters (86) and amides (73, 76, 78, 81). The ester groups find particular use as slime control agents in the papermaking industry. They compare favorably with phenylmercury salts regarding duration of activity. The amides possess both broad herbicidal activity (73, 76) and broad microbiocidal activity (78, 81). Amides having microbicidal activity generally contain the thiohydroxamate structure.

The thiocyanates (-SCN) are well known algicides which have found use in such widely diverse environments as paper-mills, cooling towers, oil well brines, drilling muds and as solutions for treating packed fruits and vegetables (65, 68, 69, 75). These materials possess an extremely broad spectrum of high level toxicity for a large number of distinctly different and unrelated microorganisms.

Among the more active and well known algicides are the heterocyclic materials such as the pyrazoles and endothal (63, 64). Endothal is a well known commercial aquatic herbicide.

Additional materials are quinone (60, 79), sulfur, sulfoxide and sulfones (62, 70, 71, 77) and the acrolein derivatives (67, 80). These materials also possess a broad spectrum of activity while not adversely affecting fish populations (80).

Several additional chemical structures deserve comment (59). The cyanodithioimidates are interesting in being able to prevent microbiological deterioration of a great variety of organic substances even when used at low concentrations and in possessing a broad spectrum of activity.

Diphenyl ethers (83) are known to be effective against sea organisms, while the organosilicon derivatives (85) are useful as agents for preventing algae buildup in filter elements, e.g. in aquariums.

The use of halogenated hydrocarbons as algicides is known (57). The relative insolubility of these compounds, particularly in water, is utilized to advantage by applying them in an emulsion to surfaces where algae abound. Being insoluble, they are effective for a long time period.

An interesting algicide is the reaction product of the insecticide Kepone™ and an aliphatic polyhydric alcohol (61). These materials are very broad spectrum biocidms as well as algicides and fungicides.

While direct chemical contact between algicide and organism is the conventional application procedure, other algicides have been developed which operate on a different principle. As early as 1924, a coagulant consisting of an aluminum salt and a carbonate was found effective, forming a gelatinous mass which coagulated the organisms as well as other impurities in the water (56). In 1966, this principle was utilized with fibrous alumina monohydrate (66). An indirect method for controlling algae was also developed. This method used finely divided alumina to absorb the dissolved phospates contained in the water, causing the death of algae by removing an essential nutrient from the media.

Mixtures

Although many of the algicides discussed above possess broad spectrum activity, they are not sufficient for all algae. There are usually several organisms in water which are not susceptible to any one algicide and these undesired species may greatly proliferate when the susceptible algae varieties are diminished. With this in mind, attempts have been made to combine two or more active algicides, each of which is known to control certain species, to form a composite which is able to control a broader spectrum of undesired organisms. In most cases the several active ingredients of the mixture will control some organisms in common; however, the mixtures disclosed in patents usually show co-action (synergism).

The earliest patented mixture for algicide control was allowed on March 6, 1877 (87). The claim was drawn to a mixture of boric acid and chloroform.

Subsequently, mixtures containing copper sulfate were disclosed (88, 89, 90, 98). Such materials as ammonium sulfate have been used as synergists for copper sulfate. In addition, a quarternary dipyridylium salt was mixed with the copper sulfate/alkanolamine complex in order to achieve a synergistic result.

Other synergistic mixtures include the algicide phenylmercuric acetate with N-cocoamine acetate (91) and endothal with diquaternary dipyridylium salt, (92).

More recently, the attention of inventors has turned to algicidal compositions having a greater spectrum of activity at lower application rates than either of the components when applied singly. Such mixtures include:

β-bromo-β-nitro styrene/laurylpyridinium chloride (93);

N-2-nitrobutyl-morpholine/polychlorophenol (94);

5-chloro-4-phenyl-1,2-dithiole-3-one/methylenebis thiocyanate (95);

2,2-dibromo-3-nitrilopropionamide/ bis 1,4-bromo-acetoxy-2-butene (96);

1,3-dichloroacetone oxime acetate/bis (trichloromethyl) sulfone (97); and

2,2-dibromo-2-cyanoacetamide/sodium iodide (99).

Future Trends

Present and future environmental concerns relating to food production and the quality and quantity of life-sustaining air and water virtually assure that the vigorous search for better algicides will continue. Recent activity indicates that much work in the future may be devoted to determining synergistic effects between known algicides.

The development of new and different algicides will no doubt continue, as well.

Technology Analysis by

Glennon H. Hollrah
Patent Examiner

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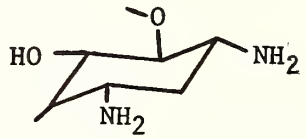
AMINOGLYCOSIDE ANTIBIOTICS [a]

Introduction

Aminoglycoside antibiotics are compounds containing the aminocyclitol moiety



or a derivative thereof, linked through a glycoside to one or more saccharide moieties.

These antibiotics, for the most part, have a broad antibacterial spectrum of activity against both gram-positive and gram-negative microorganisms. They effectively inhibit the growth and development of many of the organisms responsible for such diseases as gonorrhea, influenza, opthalmic infections, pneumonia, tuberculosis and urinary tract infections. Some of these aminoglycosides are also useful as nutritional supplements in animal feeds, or as disinfecting agents for sterilization of surgical instruments and the like.

Natural occurring antibiotics such as neamine, neomycin [b], streptomycin [c], kanamycin, paromomycin, butirosin, gentamicin, sisomicin, guintomycin, destomycin, ribostamycin, zygomicin and lividomycin as well as macrolide antibiotics, of the erythromycin type are usually produced by various microorganisms. In recent years, some of these antibiotic compounds have been synthetically produced (1-3)[d].

Due to their broad spectrum of pharmaceutical activity, this area has grown rapidly in recent years. Over the most recent three year period (1973-75), it has grown at an average annual rate of 16.3% which is 7 times the average for all technologies. The graphs on the following page illustrate this growth first by patent date and then by the application date of patents issued since January 1967[e].

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[a] The technology review in this report is substantially encompassed in U.S. Patent Classification System Class 260, subclasses 210 AB; 210E and 210K.

[b] Neomycin and derivatives thereof are separately classified in class 260, subclass 210 NE.

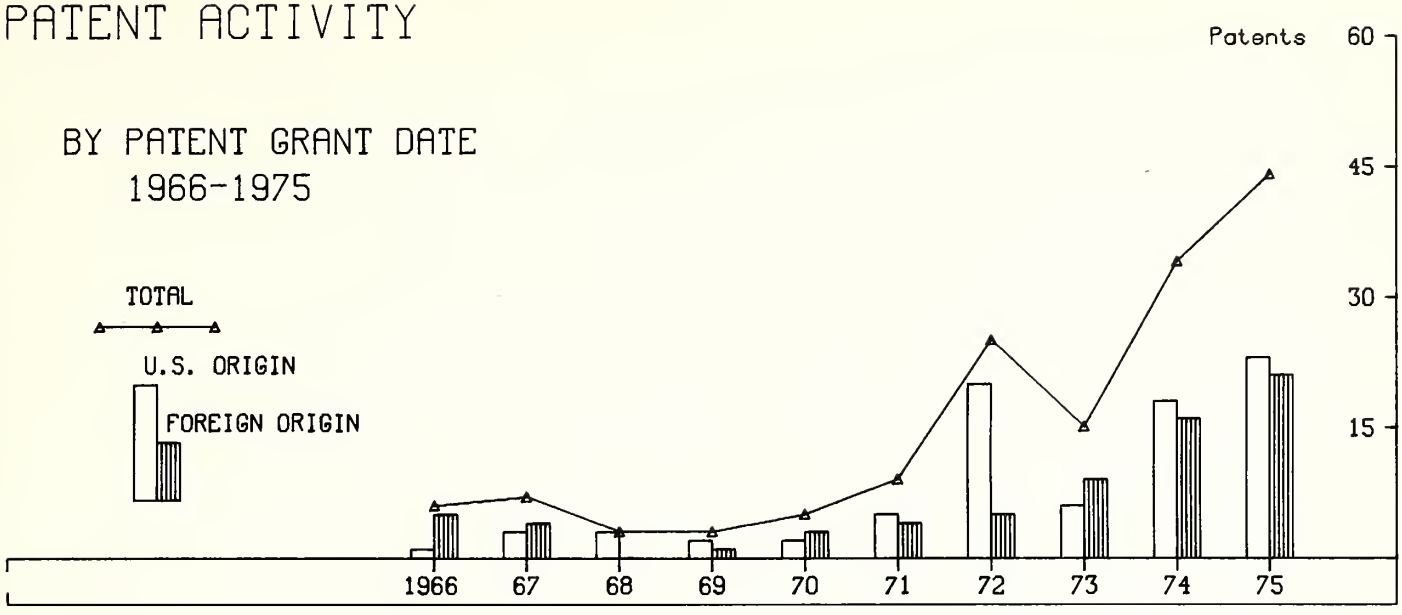
[c] Streptomycin and derivatives thereof are separately classified in class 260, subclass 210 S.

[d] Numbers in parenthesis refer to patents identified in the bibliography at the end of this report.

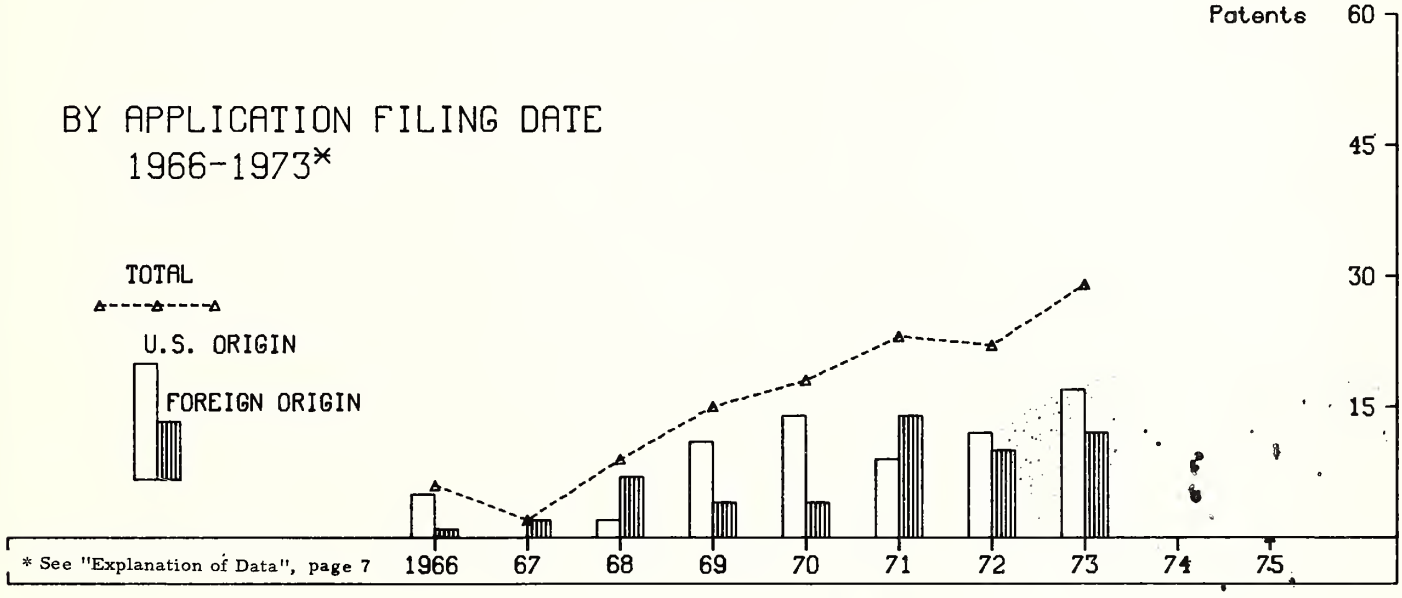
[e] See "Explanation of Date", page 7

PATENT ACTIVITY

BY PATENT GRANT DATE 1966-1975



BY APPLICATION FILING DATE 1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	6	7	3	3	5	9	25	15	34	44	151	6	2	9	15	18	23	22	29	124
UNITED STATES	1	3	3	2	2	5	20	6	18	23	83	5		2	11	14	9	12	17	70
TOTAL FOREIGN	5	4		1	3	4	5	9	16	21	68	1	2	7	4	4	14	10	12	54
JAPAN	3	2				1	2	4	12	17	41	1	1	1	2	1	7	9	11	33
ITALY		1			1	1	2	1	1	1	8			2	1	2	1	1		7
UNITED KINGDOM								2	2	1	5						4		1	5
FRANCE		1				1	1	1	1		5			1	1	1	1			4
YUGOSLAVIA				1	1	1					3		1	2						3
BELGIUM	1										1									
USSR										1	1									
POLAND										1	1									
BRAZIL					1						1			1						1
ALL OTHER (2)	1							1			2						1			1

The foreign share of the patent activity (i.e. U.S. patents granted to residents of foreign countries) amounts to 49.5% of all patents issued since 1972, which is about one third more than the average of 33% for all technologies combined. The foreign activity is shown in the country table following the graphs (previous page) both by patent date and by application date for patents granted since January 1967.

Thrust Of The Technology

Following the discovery of streptomycin (4, 5) and neomycin, (6, 7), much of the initial research effort focused on the isolation and purification of naturally occurring aminoglycoside antibiotics (8-10).

The early method of preparation was exclusively from microbiological fermentation of soil organisms. As a result, the products were found dissolved in the culture broths in which the microorganisms were grown; often making isolation and purification of these products difficult and unsatisfactory. Products were frequently obtained in low potency concentration, containing up to 75% impurities which often were highly toxic. Also, these solutions were frequently unstable and insoluble in pharmaceutical compositions (6, 11-13).

Early purification processes used ion exchange chromatography and various solvent extraction techniques (2, 5). Numerous improvements in these techniques were patented, including several on gel chromatography (14-18).

Other research effort focused on modifying the activity of these naturally occurring compounds to increase activity or minimize undesirable properties (11, 19-26).

Some potentially useful antibiotics, even when purified, elicit undesirable toxic effects. Streptomycin, neomycin and kanamycin are typical in exhibiting high antimicrobacterial activity against many different types of bacteria as well as a marked toxicity (2). Other compounds are too unstable, have a bitter taste (27, 28) or are too poorly absorbed to be useful.

Early attempts to reduce the toxic properties of known antibiotics without significantly reducing their antibacterial activity involved the preparation of the sulfate and hydrochloride salts in crystalline form. Some of these had limited solubility in water (24), requiring that the effective dose in liquid form be administered in relatively large volume, causing discomfort to the patient (14).

Other salts were also found useful. Pantothenic acid, ascorbic acid, hydroxylalkylsulfinic acid, tetracyclin, glucose phosphoric acid and hydroxyalkylsulfonic acid salts of known antibiotics were effective in increasing the spectrum of activity of these compounds. (2, 29-31).

Fatty carboxylic acid salts of neomycin were found useful in topical preparations for treatment of dermatological conditions caused by neomycin susceptable organisms (32).

In some cases it was found that esters and adducts of known antibiotics are more easily absorbed by the intestines when administered orally (12, 33-35).

The problem of instability (deterioration and discoloration) was solved in many cases by the addition of small amounts of stabilizing agents to aqueous solutions of antibiotics (16, 17, 36-39). When treated in this manner, previously unstable antibiotics maintain their potency for many years.

Many other derivatives were synthesized to obtain products having more desirable properties (40-44). Effective chemical modifications, include: 1) acylating one or more of the amino or hydroxyl groups on the antibiotic molecule (33, 45-47); 2) forming an oxime derivative of erythromycin to increase the stability of this compound (13, 34, 48); 3) forming ureide derivative of erythromycin which have a less bitter taste (49, 50); and, 4) forming cyclic boron esters of erythromycin (51).

Recently, research into the mode of action of amino glycoside antibiotics has led to many additional structural modifications of known antibiotics, resulting in synthetic derivatives having a broader activity spectrum (42, 52-54). For example, Umezawa and coworkers found that some R factor carrying strains of gram-negative bacteria resist the action of kanamycin by producing an enzyme capable of phosphorylating the 3'-hydroxy group of this compound. This led to the development of 3'-deoxy kanamycin and 3', 4' dideoxykanamycin (51, 55-57), lacking the 3'-hydroxy group, which are effective against some previously resistant strains of bacteria.

Also, analogues have been prepared which contain amino groups such as:

α - hydroxy- β -aminopropionyl -,

α - hydroxyl- γ -aminobutyryl-,

and α -hydroxyl- ε -aminovaleryl-

in the 1, 3, 6' and 2'' positions (58-61). Alkylation of the 6'amino group has also led to useful derivatives (62).

Recent advances in isolated, purifying and identifying compounds via the use of thin layer chromatography, mass spectroscopy, X-Ray analysis (63, 64), and other analytical techniques has led to the discovery of new natural occurring antibiotics. Examples include sisomicin, unsaturated aminoglycoside garamine derivatives, pseudosaccharids, gentamycin, and ambutyrosin (9, 10, 65-68).

As a result of some of the above chemical modifications and new discoveries, compounds now available have even higher antibacterial activity, and/or a lower toxicity to man and lower animals. (30, 58, 67, 69-71).

Future Trends

Efforts in the future will probably lead to the discovery, isolation and identification of new and still more effective aminoglycoside antibiotics. Refinements in isolation techniques, including gel and molecular sieve chromatography, will enable more effective separations to pure crystalline products. Once these are available, x-ray diffraction techniques, among others, will be used for structure determination of complex antibiotics.

Technology Analysis by

Johnnie R. Brown
Patent Examiner

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CATALYTIC TREATMENT OF AUTOMOTIVE EXHAUST GASES [a]

Introduction

Recognition of the need for treatment of exhaust gases from internal combustion engines in general and automotive exhaust gases in particular dates back to the turn of the century (1,2) [b] . Early attention was primarily restricted to eliminating carbon monoxide and hydrocarbons, although harmful effects of other materials, such as, tetraethyllead was also recognized (3). More recently, the undesirable effects of other exhaust gas components, such as, nitrogen oxides and sulfur oxides has gained attention (4,5).

Early patents relied on washing the gases first with water and then with other liquid absorbents (3,6). These were closely followed by use of afterburners (7) and solid absorbents (8). Catalytic treatment of exhaust gases had appeared by the 1920's (9,10). Together these methods and combinations of them have constituted the main activity in the technology to date.

Growing interest in protecting the environment and improving the quality of life by reducing automobile exhaust emisions has stimulated rapid growth in catalytic treatment of internal combustion exhaust gases in recent years. Since January 1973, patent activity in this area has been growing at an average annual rate of 22.4% which is about 10 times the average for all technologies. The graphs on the following page illustrate this growth. This activity is shown first by patent date and then by application date of patents granted since 1967 [c] .

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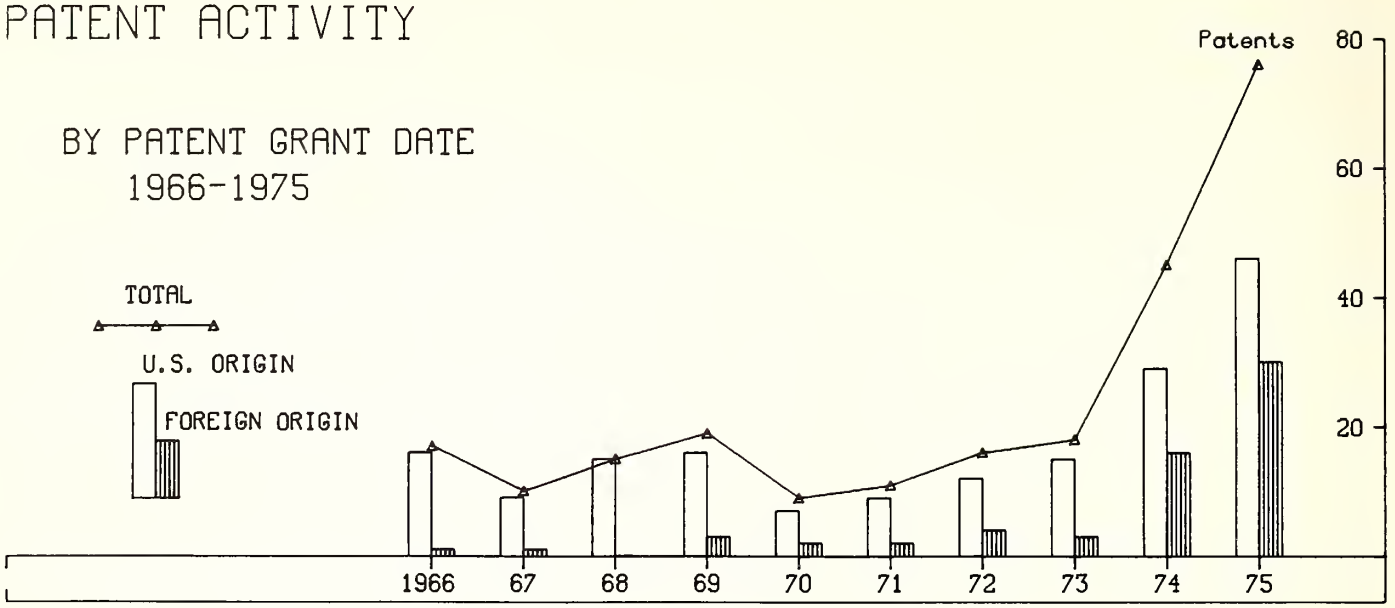
[a] The technology described in this report is contained primarily in Patent Classification System Class 423, subclasses 213.2, 213.5, and 213.7. Related material is also found in Class 423 subclass 212 and Class 55 Digest 30.

[b] Numbers in parentheses refer to patent listing in the Bibliography at the end of this report. This listing is intended to be representative rather than comprehensive.

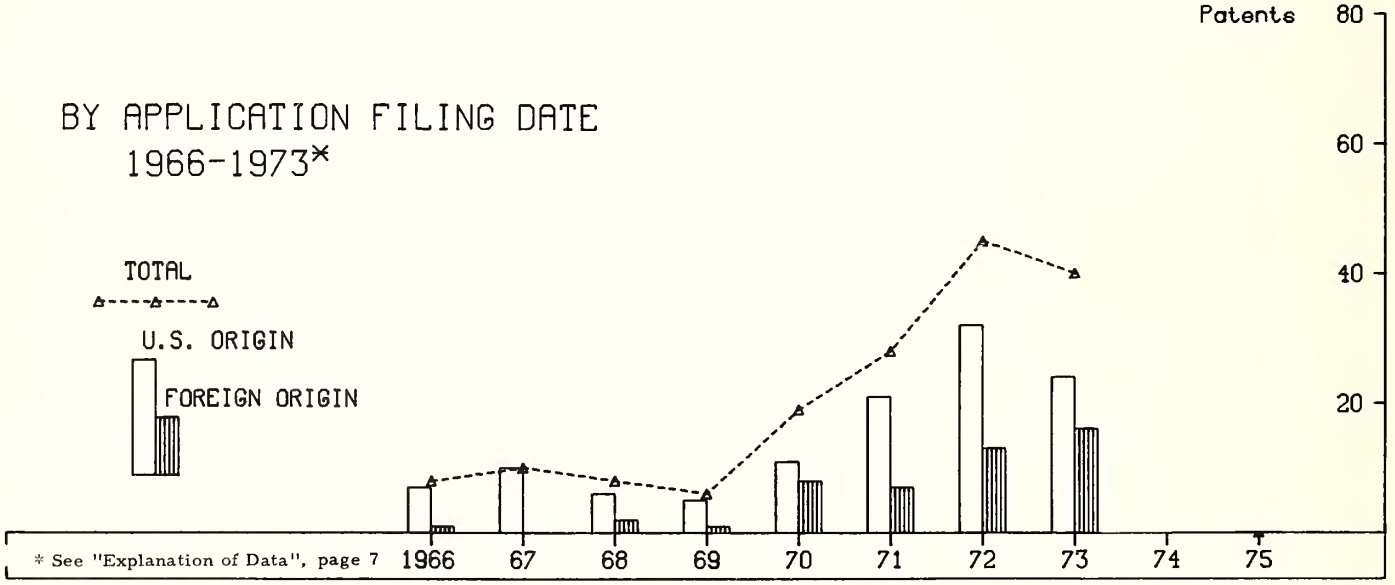
[c] See "Explanation of Data", page 7

PATENT ACTIVITY

BY PATENT GRANT DATE
1966-1975



BY APPLICATION FILING DATE
1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	17	10	15	19	9	11	16	18	45	76	236	8	10	8	6	19	28	45	40	164
UNITED STATES	16	9	15	16	7	9	12	15	29	46	174	7	10	6	5	11	21	32	24	116
TOTAL FOREIGN	1	1		3	2	2	4	3	16	30	62	1		2	1	8	7	13	16	48
JAPAN				1	1	1	2	1	6	16	28			1	1	3	2	6	10	23
GERMANY	1	1			1		1		5	9	18	1				2	2	4	4	13
FRANCE				2		1			1	3	7			1			1		2	4
UNITED KINGDOM									4	1	5						2	2		4
USSR							1				1					1				1
PHILIPPINES								1			1					1				1
ITALY										1	1							1		1
CANADA								1			1					1				1

Over the most recent three year period (1973-75), 35% of all U.S. patents in this area have been granted to foreign residents. This is slightly higher than the all technology foreign share average of about 33% for the same period. The foreign activity is shown in the country table following the graphs (previous page) by patent date and by application date for patents issued since January 1967.

Thrust Of The Technology

Attempts to remove hydrocarbons and carbon monoxide from exhaust gases have included oxidation (11), equilibration, steam reforming and water gas shift reactions (12, 13, 14).

The early catalytic processes used platinum (10); metal chromites (15), copper oxides (16, 17), iron, nickel, and cobalt oxides (12) catalysts among others (11). These were employed as free metals (9, 10, 17) coated on either a portion of the reactor (16); a metallic support (3); or a low surface area support (4, 18).

Attention during the 1950's and 1960's was directed to problems relating to attrition resistance of catalysts (4, 18), catalyst poisons, the use of scavengers (19, 20, 21, 22), and problems of temperature control (4, 18). With the recognition of the problem of nitrogen oxide exhaust emissions, two stage reduction/oxidation treatments (21, 23, 24) and more selective catalysts also began to appear (25). In some systems, ammonia was used as a reductant for nitrogen oxides (26, 27).

Porous high surface area catalyst supports (28, 29) predominated during this period. However in the 1960's, monolithic or honeycomb supports (30, 31, 32), and coated and stabilized supports (33, 34) began to appear regularly.

Federal and local legislation during the past few years has added impetus to the search for more effective and longer enduring catalysts. Discovery of problems associated with ammonia formation in the nitrogen oxide reduction stage of catalytic treatment spurred interest in selective catalysts (35, 36, 37) and subsequent ammonia decomposition (38).

In general, the approach to the treatment of exhaust gas has been divided between single stage oxidation/reduction (37, 39) and multistage treatment (35, 40, 41, 42). Although activity with respect to monolithic ceramics continues high, (40, 43, 44, 45, 46), many patentees have reverted to metallic (47) or less porous supports (48), frequently coated with porous refractory materials (43).

The use of additives to increase stability of ceramics (49, 50, 51, 52), and active and/or corrosion resistant alloys (53) appears frequently. Some recent patents have been directed either to the use of catalysts less sensitive to the frequent variations in conditions in automotive exhaust gas converters (54) or to means of compensating for such variation (40, 55).

Future Trends

The amount of future activity in this field will undoubtedly depend, to some degree, upon governmental regulation and requirement, and modifications in engine design. However, it is anticipated that there will be a continuation of effort directed toward extension of catalyst life to at least 50,000 miles, as well as development of catalysts capable of better functioning over the wide range of temperatures and operating conditions found in internal combustion engine exhausts.

Technology Analysis by

George O. Peters
Patent Examiner

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FUEL INJECTED ROTARY PISTON ENGINES [a]

Introduction

Fuel injection has been employed in reciprocating piston internal combustion engines since the turn of the century. However, because it is more complex than carburation, and has higher initial and maintenance costs, it has, in the past, never found widespread use except in Diesel engines. Recently, there has been renewed interest in fuel injection since it is superior to carburation, having higher fuel economy and giving better performance.

Fuel economy results from fuel being more uniformly distributed to the cylinders. Better performance, such as increased power and acceleration, results because (1) fuel is injected into or close to the cylinder and need not flow through the manifold; (2) increased volumetric efficiency is achieved due to elimination of carburator pressure losses, and (3) increased manifold heating occurs.

Rotary piston engines have been in existence about as long as reciprocating piston engines. However, until recently, they were not commercially feasible because of mechanical complexity and seemingly insurmountable sealing problems. It was not until the early sixties that the Wankel rotary piston engine, developed at NSU Motorenwerke in Germany, reached a state where it was both technically and commercially feasible, and a viable competitor for the reciprocating piston engine (1,2) [b]. To date, the Wankel engine is the only rotary piston internal combustion engine mass produced in the world.

While the use of fuel injection in rotary engines is not new (3-6), the development of a commercially viable rotary engine together with a desire for greater efficiency caused by increased fuel costs, has sparked rapid growth in the patent activity of this area in recent years. Over the most recent three year period (1973-75), patenting in this area has been growing at an annual rate of 16.7% which is about 7 times the average of all technologies combined. The graphs on the following page illustrates this growth. The first shows activity by patent date. The second shows this activity by the application date of patents granted since January 1967 [c].

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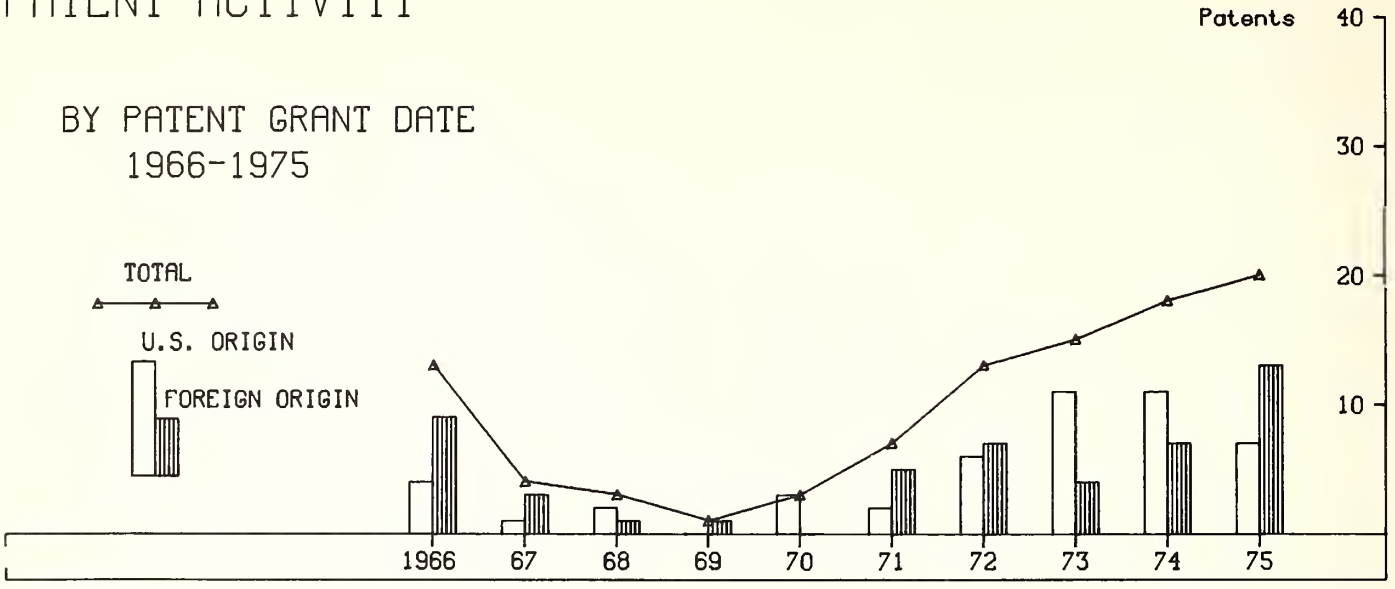
[a] The technology described in this report is contained in Patent Classification System Class 123, subclass 8.09

[b] Numbers in parenthesis refers to patents listed in the bibliography at the end of this report

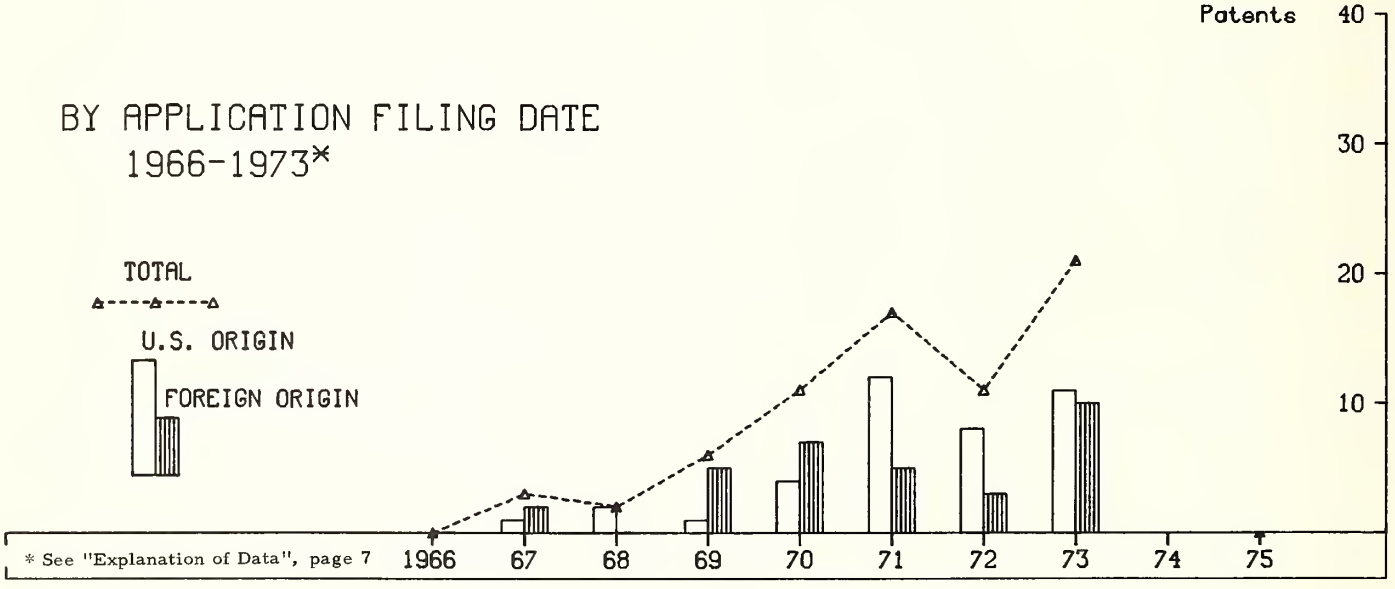
[c] See "Explanation of Data", page 7

PATENT ACTIVITY

BY PATENT GRANT DATE
1966-1975



BY APPLICATION FILING DATE
1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	13	4	3	1	3	7	13	15	18	20	97		3	2	6	11	17	11	21	71
UNITED STATES	4	1	2		3	2	6	11	11	7	47		1	2	1	4	12	8	11	39
TOTAL FOREIGN	9	3	1	1		5	7	4	7	13	50		2		5	7	5	3	10	32
GERMANY	5	2	1				4	2	3	2	19					4	4	1	1	10
JAPAN	1					3	1	1	3	10	19		1		2	1	1	1	8	14
CANADA	1			1						1	3		1						1	2
UNITED KINGDOM	1	1							1		3							1		1
FRANCE							2	1			3				1	2				3
POLAND							2				2				2					2
LIECHTENSTEIN	1										1									

Since January 1973, 45% of all U.S. patents in this technology have been granted to foreign resident inventors. This is 1.4 times higher than the all technology foreign share average of 33% for the same period. The foreign activity is shown in the country table (previous page) both by patent date and by application date for patents issued since January 1967.

Thrust Of The Technology

Recent patent activity has focused on improving the efficiency and/or reducing exhaust emissions in the following four basic types of fuel injection for rotary piston engines: (a) injection into the intake passage; (b) injection into the working chamber during its intake phase; (c) injection into the working chamber during its compression phase; and (d) injection into a prechamber.

Injection into the intake passage has the advantage of avoiding compression loss which would occur if the injection nozzle were located on the working chamber surface. Recent patents disclosing this type of injection attempt to achieve better fuel mixture preparation by employing devices which create turbulent flow of the fuel mixture. One such device consists of a helically-wound guide member within the intake channel (7). Another is an injection nozzle placed downstream from a throttle plate in the intake passage which induces eddying of the flow (8, 9). Later, a further throttle plate was added downstream of the injection nozzle to increase turbulence (10).

In engines employing injection into the working chamber during its intake phase, improved mixture formation is obtained by injecting fuel through apertures in the peripheral faces of the engine rotor (11, 12). The heat of the rotor ensures proper fuel vaporization while rotation of the rotor causes the individual fuel particles to be propelled at the same peripheral speed as the working chambers. This avoids inertial lag of the particles which causes them to concentrate in the trailing portion of the working chamber.

In contrast to the previously described systems which strive to obtain a homogeneous fuel mixture throughout the working chamber, rotary engine fuel injection types b, c and d may employ charge stratification, a process wherein the lean and rich fuel mixtures are kept separate until time for combustion. In this system one portion of the working chamber contains a rich fuel-air mixture and another portion the lean fuel-air mixture. Ignition is initiated in the rich mixture, and the flame spreads or "torches" to the lean mixture.

Charge stratification allows the use of a leaner overall fuel mixture which not only is more economical but also results in reduced hydrocarbon emissions. This is noteworthy since the design of the Wankel rotary engine is conducive to poor combustion. The working chamber shape of the Wankel rotary engine during initial combustion is both very shallow,

with a high surface to volume ratio, and extremely narrow as the rotor moves past top dead center. Consequently, complete combustion does not occur at the chamber surfaces, due to quenching, nor in the tailing portion of the working chamber due to its extremely narrow shape. While unburned hydrocarbons resulting from such poor combustion can be handled by add on devices, such as afterburners, these normally are detrimental to fuel economy.

Since charge stratified engines appear capable of reducing pollutants without decreasing fuel economy, much of the recent rotary engine fuel injection patent activity is drawn to engines of this type. The following systems all employ charge stratification.

In stratified engines which inject fuel during the intake phase, the rotor surface may be formed with pockets into which the fuel is injected to form a rich mixture therein (13, 14). An alternate method is to inject fuel or rich mixture into a certain working chamber portion while intaking air or lean mixture through the intake (15, 16, 17).

A form of stratification which is currently receiving extensive research and development consists of injecting the fuel into the working chamber during the final phase of compression (21, 22). Due to the short time interval between injection and ignition, the mixture is subjected to turbulence for only a short period of time and effective stratification is maintained. To ensure ignition of the mixture, the fuel is injected near the ignitor (23, 24, 25, 26) or the injector itself may act as an electrode to receive the spark from the ignitor (27, 28). Another approach to further insure ignition is the use of dual injection nozzles (29). One nozzle is placed near the ignitor and injects a constant amount of fuel to provide a torch effect to ignite the fuel injected by the main injector nozzle.

To achieve thorough combustion of the stratified mixture, engines may employ a pre-combustion chamber which connects with the working chamber through a narrow passage near the minor axis of the epitrochoid (18, 19, 20). Fuel is injected into the prechamber to form a rich mixture, ignited, and then torched into the main combustion chamber to ensure ignition of the lean mixture therein.

Future efforts probably will concentrate on further improving fuel economy and reducing exhaust emissions by refining the use of fuel stratification. Most likely, this will be accomplished in part by improving engines which form a stratified charge by the injection of fuel into the working chamber during its compression phase.

Technology Analysis by

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Patent Examiner

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INTAKE PHASE INJECTION

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PRE-COMBUSTION CHAMBER INJECTION

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COMPRESSION PHASE INJECTION

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3,292,600	Liebel	Maschinenfabrik Augsburg Nurnberg A.G.	Germany
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3,699,929	Ishikawa	Nissan Motor Co., Ltd.	Japan

FOUR CHANNEL SOUND SYSTEMS [a]

Introduction

Four channel stereo, better known as quadraphonic sound, is a sound system designed to reproduce an acoustical event such that the listener perceives himself as being surrounded by the sound. Employing four speakers, two front and two rear, this system enables the listener to hear reproduced sounds from many different directions, distributed over the total volume of the listening room.

In theory, four channel stereo has two advantages that one cannot obtain in the conventional two channel (stereophonic) system. First, four channel stereo can more accurately recreate the concert hall ambiance effect in home entertainment sound systems by simulating the reflective effects of the side and rear walls of the concert hall. Secondly, because the four channel system gives enhanced sound dispersion, the listener is freed from the "center of the room", giving him more mobility.

The first patent suggesting a four channel stereo implementation was granted in 1968. However, additional developments did not occur immediately. Little patent activity in this technology is noted until about 1972 when growing consumer interest apparently sparked rapid develop - ment of recording and reproducing systems utilizing the four channel concept.

Over the most recent three year period (1973-75), the patent activity in four-channel technology has been growing at an annual rate of 112.2% which is about 49 times the average for all technologies combined. The graphs on the following page illustrates four channel system patent activity first by patent date, and then by patent application date for patents issued since 1967[b].

In the field of four-channel sound, the foreign share of the U.S. patent activity is large with 60% of the patents issued since January 1973 having been granted to residents of foreign countries. This is almost twice the all technology average foreign share of 33% for the same period. The country table which follows the graphs (next page) shows the distribution of patents in this field both by patent date and the application date of patents granted since January 1967.

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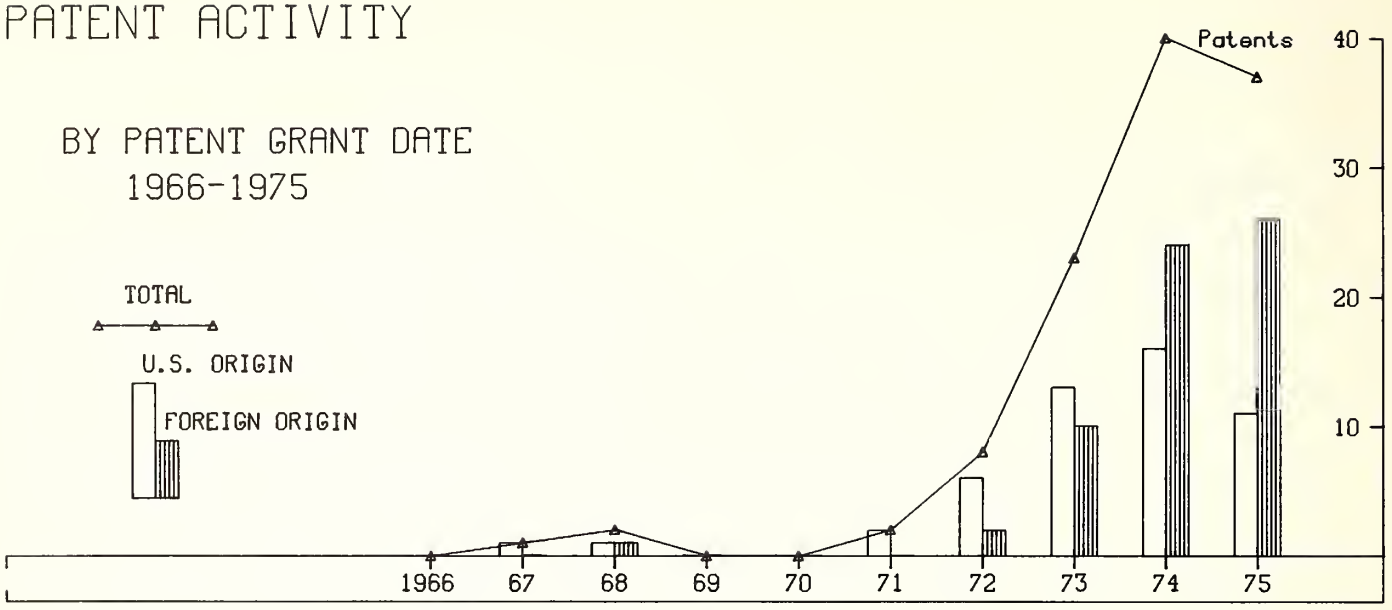
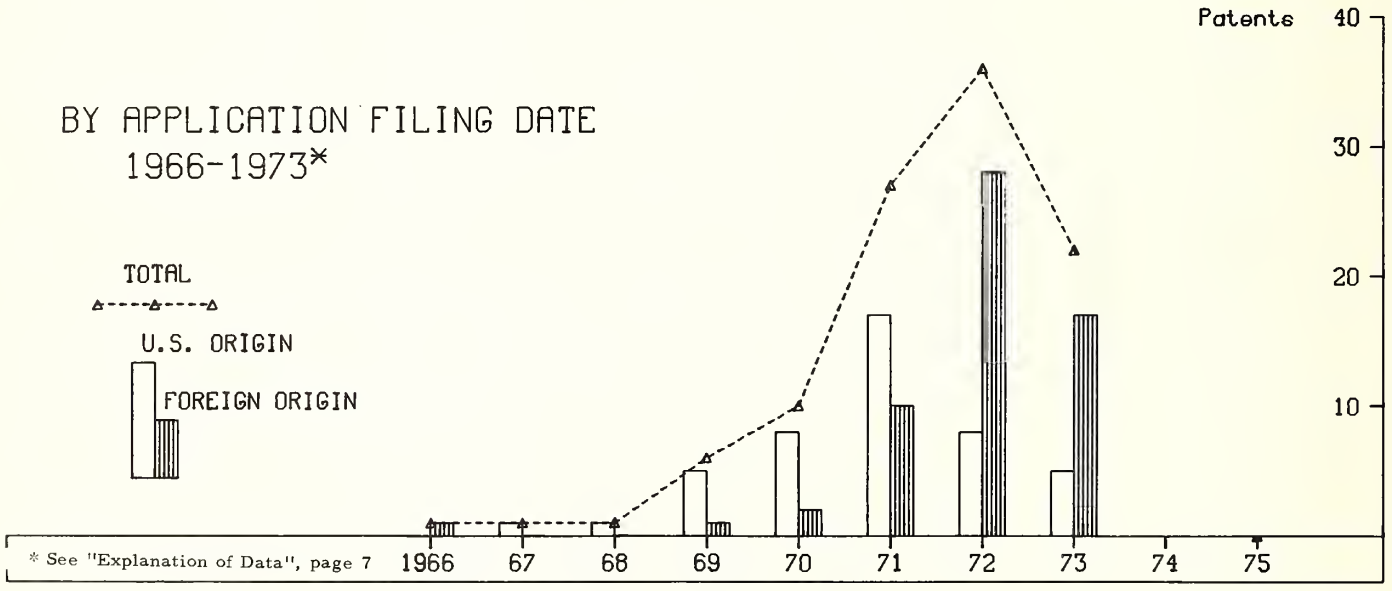
[a] The technology described in this report is contained primarily in Patent Classification System Class 179, subclass 1GQ. Related material is also found in Class 179, subclasses 15BT and 100.45T.

[b] See "Explanation of Data", page 7

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS		1	2			2	8	23	40	37	113	1	1	1	6	10	27	36	22	104
UNITED STATES		1	1			2	6	13	16	11	50		1	1	5	8	17	8	5	45
TOTAL FOREIGN			1				2	10	24	26	63	1			1	2	10	28	17	59
JAPAN			1				2	9	21	23	56	1			1	1	10	25	15	53
GERMANY								1		3	4					1		1	1	3
UNITED KINGDOM									1		1							1		1
LUXEMBOURG									1		1								1	1
CANADA									1		1							1		1

The country of origin distribution of the 113 patents that were found to have been granted in this field is shown in the tables on the previous page.

Thrust Of The Technology

Early in the development of four-channel systems, two different design philosophies surfaced. The proponents of one philosophy wanted a system which could be made compatible with existing monaural and two-channel systems and not require any additional audio bandwidth for recording or reproducing. The "matrix" system concept was developed to satisfy these constraints.

The proponents of the other philosophy wanted a four-channel system which provided as much signal separation as that in a two-channel system in addition to the compatibility feature. The "discrete" system concept which requires a doubling of audio-bandwidth over that used in two-channel stereo, was developed to provide this desired signal separation and compatibility.

Matrix System

The "matrix" principle utilizes two composite signals which are formulated (encoded) by combining four independent audio signals with preselected amplitude and phase relationships. Scheiber (1)[c] was the first to show how four audio signals labeled F, L, R, X can be combined to yield the following two composite signals:

$$A = L + .707F + .707X$$

$$B = R + .707F - .707X$$

These two composite signals are then processed in the same way as the normal left and right signals in two-channel recording. Thus, to record four information channels on a record, composite signal A, for example, is recorded on the right wall of a record groove and composite signal B is recorded on the left wall of the same groove. In the reproduction of four channels from the record, the two composite signals are combined utilizing preselected amplitude and phase relationships (decoded) to provide four output signals for application to appropriate amplifiers and speakers. In Scheiber's basic system, the four output signals are:

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[c] Numbers in parenthesis refer to patents listed in the bibliography at the end of this report.

$S_1 = A = L + .707F + .707X$

$S_2 = B = R + .707F - .707X$

$S_3 = .707(A+B) = F + .707L + .707R$

$S_4 = .707\ (A-B) = X + .707L - 707R$

These output signals illustrate the principle drawback of "matrix" four-channel systems, that is, the lack of substantial separation of the original audio signals L, F, R, X from undesired added signals upon decoding. The actual separation of the desired output signal from each undesired signal component is 3db, which is considered poor for multi-channel reproduction. The principle advantage of the "matrix" system is that no additional audio bandwidth over that used for two-channel audio systems is required for recording/reproducing the two composite signals.

The development of matrix encoding and decoding systems has been, for the most part, the work of two corporations, Columbia Broadcasting Systems, Inc. (CBS) in the United States (with the "SQ" system) and the Sansui Electric Co., Ltd. in Japan (with the "QS" system). Each has produced encoding/decoding systems which differ in both relative amplitudes and phase relationships between (1) components of the composite signals upon recording and (2) the output signal applied to each corresponding speaker upon playback.

Examples of encoders and decoders employed by CBS are shown in the patents to Bauer (2, 3), and by Sansui in the patents to Takahashi and Ito et al (4, 5). Takahashi (6) illustrates a decoder usable with either the "SQ" or "QS" system. The patent activity indicates that both CBS and Sansui continue to provide refinements in their respective systems.

The development of separation enhancement systems has been a part of the ongoing effort by both CBS and Sansui. In general, they employ different but related techniques. CBS uses a gain riding technique (7, 8, 9) employing logic control signals which instantaneously control the amplitude of the output signals to the speakers.

Sansui uses a similar technique utilizing variable matrix decoding (10). Here, control is applied to the signal combining circuitry to control the relative combining levels of the two composite signals in the decoder. This enables the amplitude levels of the output signals to the speakers to be varied.

Discrete System

The "discrete" four channel principle, known as "CD-4," involves combining pairs of four independent audio signals (i.e., channels 1, 2, 3, and 4) into sum signals and difference signals. Each difference signal is

modulated onto a carrier frequency of 30KHz. Subsequently, the modulated 30KHz carrier is frequency division multiplexed with the sum signal of the corresponding pair of channels. Thus, there are two outputs each consisting of a baseband audio sum signal and a carrier modulated by an audio difference signal. These two outputs are recorded on the two walls of a record groove.

Upon playback, it is required to 1) pick up and separate the modulated components from the baseband components, 2) subsequently demodulate the difference signals from each wall of the record groove, and 3) finally combine the sum and difference signals in respective pairs of conventional two channel decoders to provide the original four independent audio channels.

More bandwidth is required to record and reproduce four channels of audio information with the "CD-4" system but the separation between channels is the same as that in a regular two-channel system.

The majority of the discrete four channel technology belongs to the Victor Corp. of Japan, Ltd. (JVC). CBS has some activity in this area differing basically from the JVC system in the scheme of modulation applied to the difference signals.

Discrete four-channel technology began at JVC with the contribution of Takayanagi (11). Prior to recording he added a frequency modulated independent audio signal to each of two independent baseband audio signals in order to provide a frequency division multiplexed pair of signals on each wall of a record groove. The purpose was to add a third dimension to the sound field provided by conventional two channel sound systems.

Takayanagi indicated that the added frequency modulated signal did not have to be the same in both channels. However, he comments that crosstalk would be too high if two different frequency modulated signals were used and further states that it would be difficult to record two kinds of signals respectively on the two walls of a groove. Takahashi (12) provided the first practical discrete four-channel sound recording/reproducing system which is the basic system used today.

As an alternative approach to the frequency modulation technique of JVC, CBS developed a single sideband (SSB) amplitude modulation approach combined in the recording process with predistortion compensating networks to deal with the inherent envelope distortion of the SSB signals, (13, 14).

Advances by JVC in "CD-4" technology are shown in Ohwaki (15) and Takahashi (16) who illustrate systems employing level and phase control of the modulated carrier upon recording. Ishigaki (17) illustrates a carrier demodulation circuit which provides reduced interference effects upon reproduction, due to the nearness in frequency of the multiplexed signals in each channel. Takahashi et al (18, 19) and Itoh (20) employ phase-locked loop frequency modulation demodulators.

Takahashi (21) uses a compression/ expansion system for reduction of crosstalk between the frequency modulated signals. Takahashi et al (22) teach the use of muting circuitry for increased compatibility when two-channel or four-channel recordings are selectively chosen for reproduction. Ishigaki et al (23) show the application of crosstalk compensation correction signals applied prior to recording.

F-M Broadcasting

Another area of interest in the field of four channel sound is that of F-M Broadcasting. No one company has dominated the patent activity in the four channel broadcasting art and various discrete signal formats for the transmission of four information signals have been patented.

Dorren (24) introduced the first four channel broadcasting system compatible with presently used monophonic and two channel receivers. Since then other systems have appeared which perform the same task. Takaoka (25), Parker (26), Dorren (27), Cho (28), Fockens (29) and Mallon (30) have made contributions to the four-channel signal broadcasting art by providing various techniques to combine the four independent audio signals at the transmitter for easy recovery at a receiver while still providing signal quality comparable to that of a two-channel system. Limberg (31) has developed a flag detector to indicate whether a two or four-channel signal is currently being received and has combined it with a switching device responsive thereto for activating appropriate circuitry.

The various transmission schemes available are currently under consideration by the Federal Communications Commission who will decide which system will be adopted as standard throughout the United States.

Other Developments

Other patent activity in the four channel field is drawn to components or accessories used in these sound systems. Devices such as four channel synthesizers (32-40) , balance control systems (41-45), four channel headphones (46-50) and combination two/four channel tape playing systems (51-53) have been disclosed. There is no particular national or corporate predominance in this area of diverse patent activity.

Trends

The trends in patent activity in the "matrix" four-channel field appear, at the present, to be directed toward improved forms of separation enhancement decoding circuits. Some direction is noted in the area of providing separation enhancement logic systems in integrated circuit form for use with a decoder upon playback. No other significant paths of technological development can be discerned in the "matrix" four-channel field at this time.

In the "discrete" four-channel field, the current general trend of patent activity seems directed toward improvements in the application of phase locked loop demodulation techniques and playback muting circuitry for better signal separation, lower distortion and higher noise immunity.

Technology Analysis by

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		TAPE PLAYINGS SYSTEM	
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SECTION II

ENERGY TECHNOLOGIES

Introduction

In its Early Warning Report, December 1973, OTAF reviewed patent activity from 1963-1972, in areas relating to solar, geothermal, and tide and wave energy. In this Section, that review is updated with the addition of three more years of data (1973-1975), and the solar energy coverage is broadened to include solar concentrators and collectors.

Also to be found in this Section are reviews of two energy areas not previously covered in this report series. First, two uses of waste material as an energy source are examined, specifically:

- the burning of waste material to produce steam or hot water which may, in turn, be used as an energy source; and

- the conversion of waste material into another useable fuel (e.g., methane).

The second energy area to be newly reviewed is the use of wind power for electricity generation (e.g., windmills).

The Reports

For all but the wind energy report, the format used is that of the "mini-report" described in detail beginning on page 6 of this publication. The reader is referred and urged to read this material for an explanation of the data presented -- particularly the data relating to patent activity distributed by patent application date, rather than patent grant date.

The wind energy review is similar in form to the Section I "examiner reports" which consider the thrust of the technological activity represented by the patenting in the area.

The reader should note an important point of difference in the growth index presented in Section II, as compared to Section I. In this Section, the "Average Percent Growth" for 1973-1975 considers only the patenting in the preceeding decade, 1963-1972, as a base for computing growth. In Section I, that base included all preceeding years.

The most obvious effect of this difference is a general increase in growth rate figures. When referenced to the smaller and more current base of patenting (1963-1972), the average yearly growth for 1973-1975, for all technologies combined is approximately 10.5%, as contrasted to the corresponding 2.3% all technology growth average encountered in Section I. Thus, the reader should use the larger figure as a base of comparison when considering the significance of the growth rate figures contained in this Section.

Below are listed the energy area reports contained in this Section.

TECHNOLOGY	PAGE
Solar	
Heaters, and space heating and cooling systems	132
Distillation and evaporation concentration	134
Direct conversion to electrical energy	136
Direct conversion to mechanical energy	138
Solar collectors and concentrators	140
Geothermal and other natural terrestrial heat energy	142
Tide and wave energy	144
Hot water or steam production from waste materials	146
Production of fuel from waste material	148
Electricity generated by wind (Examiner Report)	150

HEATERS, AND SPACE HEATING AND COOLING SYSTEMS

This area includes:

1. apparatus for generalized heating applications using solar thermal radiation, such as cooking stoves, household water heaters, and swimming pool heaters.

2. systems utilizing solar thermal energy for space heating and/or cooling, primarily for buildings. The heating systems include a means for heating a fluid using solar energy. The heated fluid itself may be circulated throughout an enclosed space. Alternatively, the heat of the fluid may be transferred to a heat reservoir (such as a large storage tank or bin of rocks) where the heat is stored and, subsequently, circulated as needed. The solar powered cooling systems use solar energy as the heat source in a gas absorption refrigeration system. (Class 34, subclass 93; Class 62, subclass 2; Class 126, subclasses 270, 271; Class 237, subclass 1A; and, selected patents from Class 165, subclasses 18, 48, 64 and Class 137, subclass 11).

Average Annual Activity Indices (1973-75)

Growth*	13.9%	Corporate Owned	37.3%
Foreign Share	10.7%	Government Owned	6.7%

Recent Activity

Patent activity since June 1975 includes use of solar energy in space heaters, pool heaters and solar boilers. Examples of recent patents are:

3,889,742 (Rush et al, Gas Developments Corp.) - Discloses an open-cycle type air conditioner (e.g. open flame natural gas) using a low temperature heater and a high temperature heater. Solar energy can be used as the power source for the low temperature heater.

3,893,443 (Smith) - Discloses a floating solar heater for swimming pools in the form of small pan-like vessels. The vessels have blackened inside surfaces and a translucent cover. A number of vessels are placed in the pool when not in use, and removed just prior to use.

3,894,345 (Zeltmann) - Discloses an apparatus for drying materials such as soybeans, corn, etc. The apparatus employs a draft-accelerating stack over the material to be dryed. The stack has a double wall separated by an air space. The outer wall of the stack allows ultra violet light to reach the blackened inner wall which in turn heats the air inside the stack.

3,894,528 (Stubblefield, Broyles & Broyles, Inc.) - Discloses a solar system using a dilute solution of salt. Sunlight is used to vaporize the solution in a container, creating a concentrated solution and moist air. Each is conveyed to a chamber where they are mixed, the moisture being absorbed by the concentrated solution, giving up latent heat of vaporization. The mixing thus dilutes and heats the solution which may be used as a heat source and then recycled.

3,902,474 (Pyle) - Discloses a solar heat converter in the form of a box with a maze of air passageways. The passageways are partially filled with a shredded heat conductive material, such as black colored aluminum. The box is exposed to sunlight and air is heated when forced through the passageways.

3,908,631 (Rom) - Discloses an elongated inflatable tubular solar heat collector which may be used as a source of warm air for drying grain. The collector is made of plastic, placed on the ground, and kept inflated by the pressure of the air passing through it.

3,908,632 (Poulsen, Universal Oil Products Co.) - Discloses a heating system using air with entrained black body particles. After the particles absorb solar heat, they are separated from the air and transferred to a reduced volume heat exchange zone. The cooled particles are subsequently recombined with the air and recycled.

3,927,659 (Blake et al, Martin Marietta Corp.) - Discloses a solar boiler and superheater for powering a steam turbine generator. Some of the features of the boiler are a frustoconical reflecting concentrator, a light window in the focal plane of the concentrator, and provision for cooling the window and concentrator while simultaneously preheating the boiler feed water.

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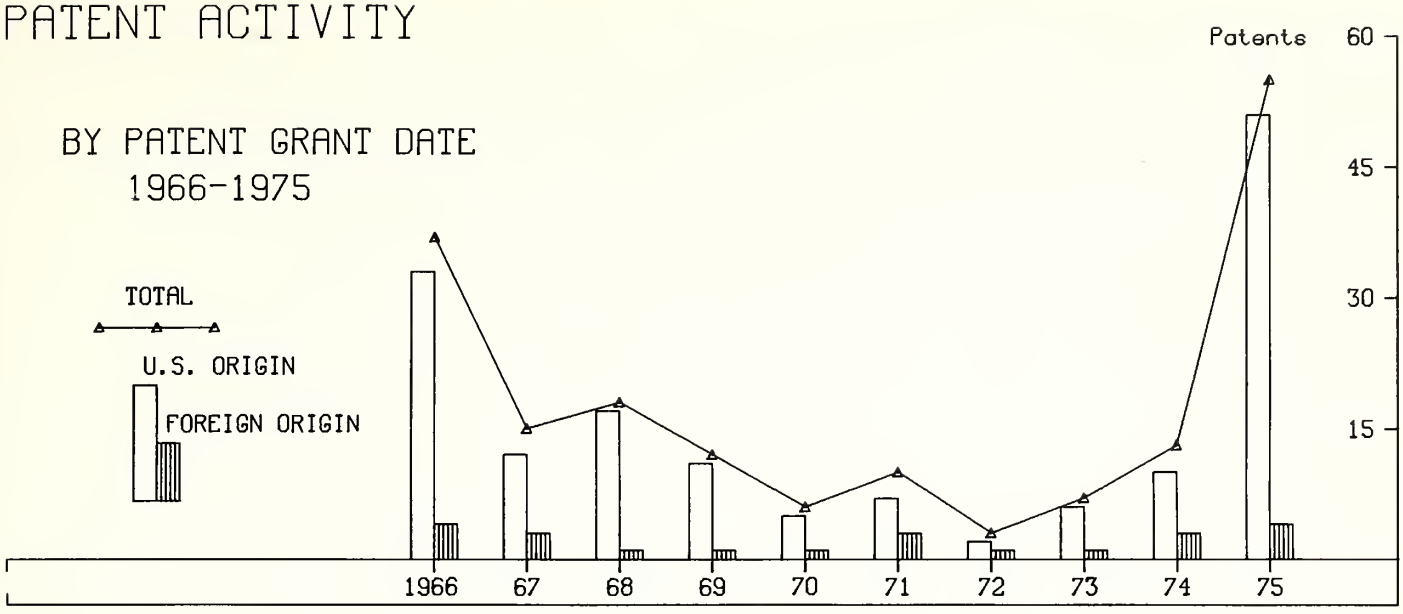
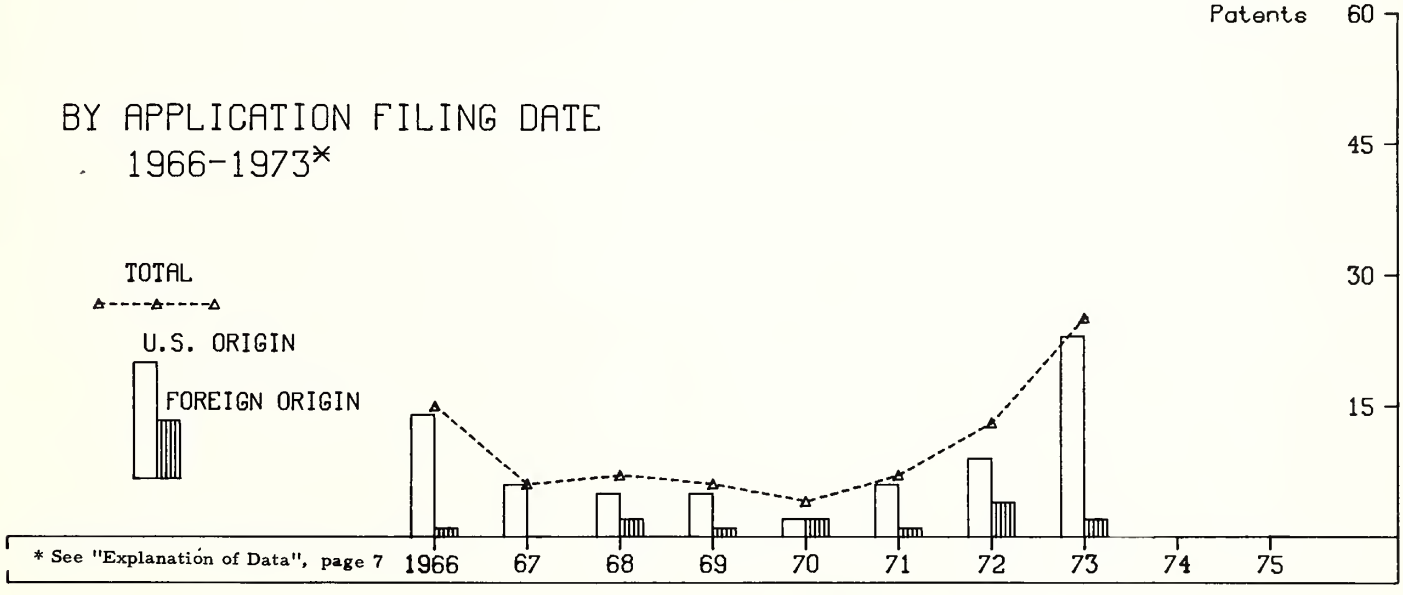
*See last paragraph on page 130

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	37	15	18	12	6	10	3	7	13	55	176	15	6	7	6	4	7	13	25	83
UNITED STATES	33	12	17	11	5	7	2	6	10	51	154	14	6	5	5	2	6	9	23	70
TOTAL FOREIGN	4	3	1	1	1	3	1	1	3	4	22	1		2	1	2	1	4	2	13
SWITZERLAND	1						1		1		3					1			1	2
FRANCE		2				1			1		4					1		1		2
GERMANY										3	3							3		3
JAPAN	1	1				1				1	4				1					1
UNITED KINGDOM	1					1					2			1						1
CANADA	1				1				1		3			1					1	2
ISRAEL			1								1									
ITALY				1							1	1								1
USSR								1			1						1			1

DISTILLATION AND EVAPORATION CONCENTRATION

This area includes apparatus and processes for effecting distillations and evaporation concentrations. The distillations are separatory processes for obtaining a desired liquid (such as potable water) from a mixture or solution. The evaporation concentration process generally involve evaporating a liquid from a mixture or solution to obtain a concentrated residual material such as a salt or brine. (Class 159, subclass 1S; Class 203, Digest 1; and, selected patents from Class 202, subclass 234)

Average Annual Activity Indices (1973-75)

Growth*	4.6%	Corporate Owned	20.0%
Foreign Share	10.0%	Government Owned	0.0%

Recent Activity

Recent patent activity focuses on solar stills for water purification. Patents, issued since April, 1972, include:

3,655,517 (Hensley et al) - Discloses a molded plastic solar still for vaporization and condensation of water. In one embodiment, a still made of foam plastic (e.g. expanded polystrene or polyurethane). Solar still is used to produce potable water from saline water.

3,703,443 (Evans) - Discloses a solar still that floats in the liquid environment from which distillate is to be extracted. It consists of a hemispherical flexible membrane attached to a base frame. At least a portion of this membrane is transpatent to permit access of solar energy which is converted to heat.

3,775,257 (Lovrich) - Discloses a solar distillation apparatus for converting sea water into fresh water. A transparent dome condenses solar energy and heats sea water in a container beneath it. The periphery of the dome is provided with a continuous channel for conveying vaporized liquid into a condenser tank, and means are included for collecting rain water.

3,785,931 (Coffey et al, ESB, Inc.) - Discloses a self cleaning tubular solar still consisting of a microporous evaporator having a dark outer surface housed within but separate from a transparent tube.

3,801,474 (Castellucci et al, Pittsburgh Corning Corp.) - Discloses the use of ceramic nodules floating on the upper surface of salt water within a container to produce fresh water. A film of salt water continuously forms on the upper surface of the nodules, is subjected to elevated temperatures, and distilled.

3,870,605 (Sakamoto) - Discloses a solar still with provision for catching rain water.

3,875,926 (Frank) - Discloses a system using a solar collector and concentrator to heat a pipe which transmits vapor produced therein to a remote condenser. Condensation at the condenser produces usable heat and purified water.

3,880,719 (Massie) - Discloses a solar still using an evaporating tray with a replaceable solar absorbing liner. The weight of the fluid in the tray deflects a tray which is coupled to the intake and exit valves to control the level of fluid in the tray.

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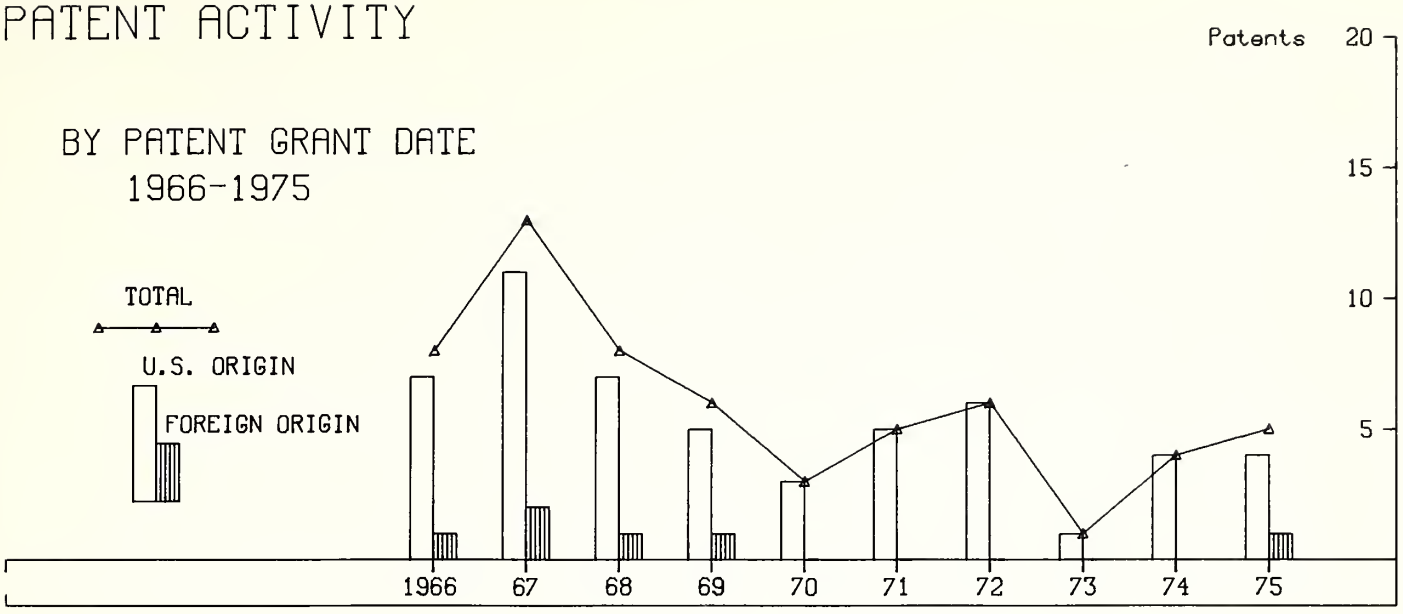
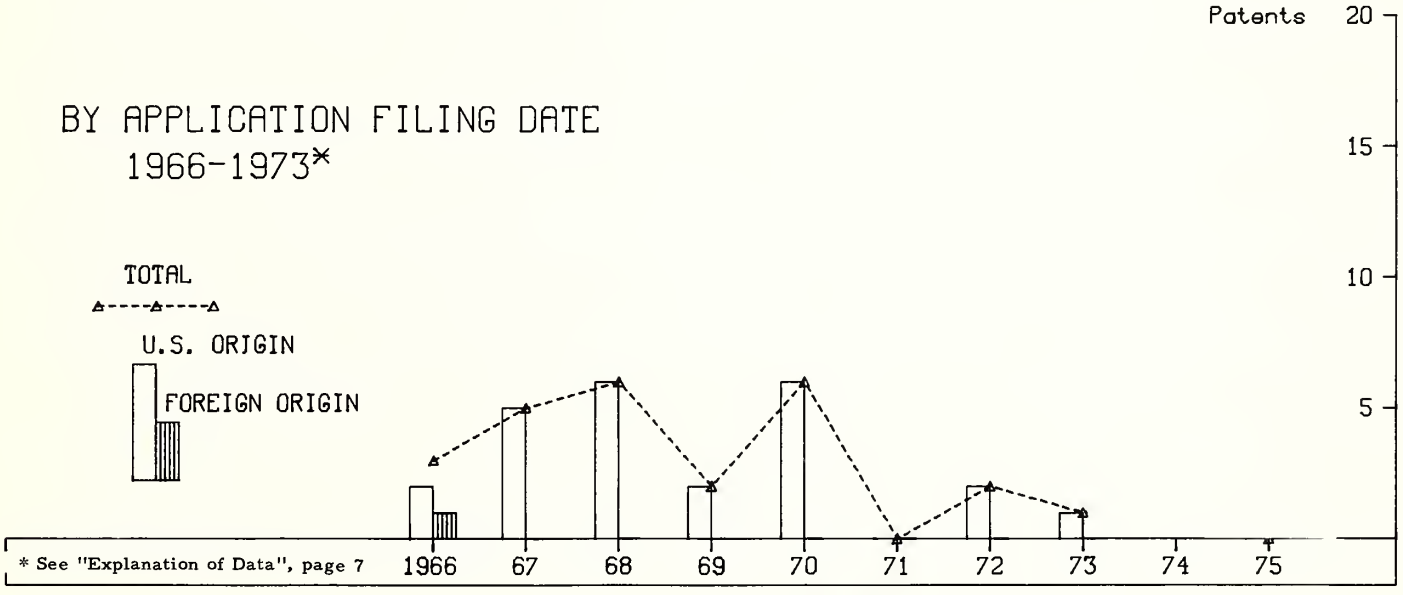
* See last paragraph on page 130

PATENT ACTIVITY

BY PATENT GRANT DATE 1966-1975



BY APPLICATION FILING DATE 1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	8	13	8	6	3	5	6	1	4	5	59	3	5	6	2	6		2	1	25
UNITED STATES	7	11	7	5	3	5	6	1	4	4	53	2	5	6	2	6		2	1	24
TOTAL FOREIGN	1	2	1	1						1	6	1								1
JAPAN	1	1	1								3	1								1
SPAIN				1							1									
MOROCCO										1	1									
WEST INDIES		1									1									

DIRECT CONVERSION TO ELECTRICAL ENERGY

This area includes devices which convert solar radiant energy directly into electrical energy using photoelectric and thermoelectric principles. Included is material related to the construction of individual electrical generating units (solar cells), as well as to large scale arrays of such units (solar panels). (Class 136, subclass 206 and selected patents from Class 136, subclass 89; Class 250, subclasses 211J, 212, 215; Class 310, subclass 4R; and Class 320, subclasses 2, 3, 5, 6, 9, 14, 15, 23, 30, 35, 39, 40, and Digest 1.)

Average Annual Activity Indices (1973-75)

Growth*	9.6%	Corporate Owned	74.1%
Foreign Share	36.2%	Government Owned	19.0%

Recent Activity

Recent activity generally focuses on solar cells and methods that more efficiently convert solar energy to electricity. Patents, issuing since December 1971, include:

3,630,020 (Chase et al, The Boeing Co.) - Discloses a servomechanism for continuously pointing a solar array toward the sun. The solar array is mounted on one end of a shaft. A plurality of bimetallic elements are connected to a crank at the other end of the shaft. As the elements deform from the heat of the sun, they actuate the crank to rotate the shaft, keeping the solar array properly oriented.

3,672,999 (Barbera, United States) - Discloses two solar arrays connected together such that when one array is exposed to radiant energy, the other unexposed array's cells act as shunt diodes for any non-functioning cell in the exposed array.

3,675,026 (Woodall, IBM Corp.) - Discloses a gas solar cell. High efficiency is obtained by having the p.n junction close to the optical surface. A window layer of $Ga_{1-x}Al_xAs$ is an integral part of the procedure for forming the p-n junction.

3,696,286 (Ule, North American Rockwell Corp.) - Discloses a power solar cell array containing a smaller reference solar array. An electrical circuit uses the reference array to determine when excess power is available and uses any excess to charge a storage battery.

3,844,843 (Kay et al, Philco-Ford Corp.) - Discloses a solar cell that uses an organic semiconductor contained in a gel of agar.

3,879,228 (Theodorou et al, United States) - Discloses a device to convert incident radiation to electrical energy using a photochemically reversible galvanic cell. The cell contains a potassium chloride aqueous electrolyte, an electrode of platinum coated with silver chloride, and an electrode of platinum.

3,781,647 (Glaser, Arthur D. Little, Inc.) - Discloses a system for collecting solar energy and converting it to microwave energy on a space satellite system. The microwave energy is then transmitted to earth and converted to electrical power.

3,860,863 (Lamprecht, Rowenta-Werke GmbH) - Discloses an electrical circuit which converts the low voltage received from a solar cell to a higher voltage. The circuit uses an oscillator whose operation is dependant on the voltage level supplied by the solar cell. Since this voltage level varies with the amount of illumination received, a photosensitive device, exposed to the same illumination, is used to adjust the oscillator for changes in voltage level.

3,903,427 (Pack, Hughes Aircraft Co.) - Discloses an arrangement of connecting leads to a solar cell in an array by taking the front leads through the cell to its back surface, instead of across its surface. This decreases the temperature of the cells by eliminating some of the power losses, does not increase size or weight, and is said to result in a 10 percent increase in useful power.

3,907,595 (Lindmayer, Communications Satellite Corp.) - Discloses a solar cell using a metal layer beneath the p.n junction. This improves efficiency by reflecting unused light back to the junction, and also produces photo excited charge carriers at the metal-semiconductor (barrier contact) interface.

3,929,510 (Kittl, United States) - Discloses a system using a solar cell combined with a radiation converter. The converter (containing ytterbium oxide and small amounts of another rare earth oxide) receives solar radiation and converts it to a band-emission spectrum that provides a good match with the spectral response of a silicon cell.

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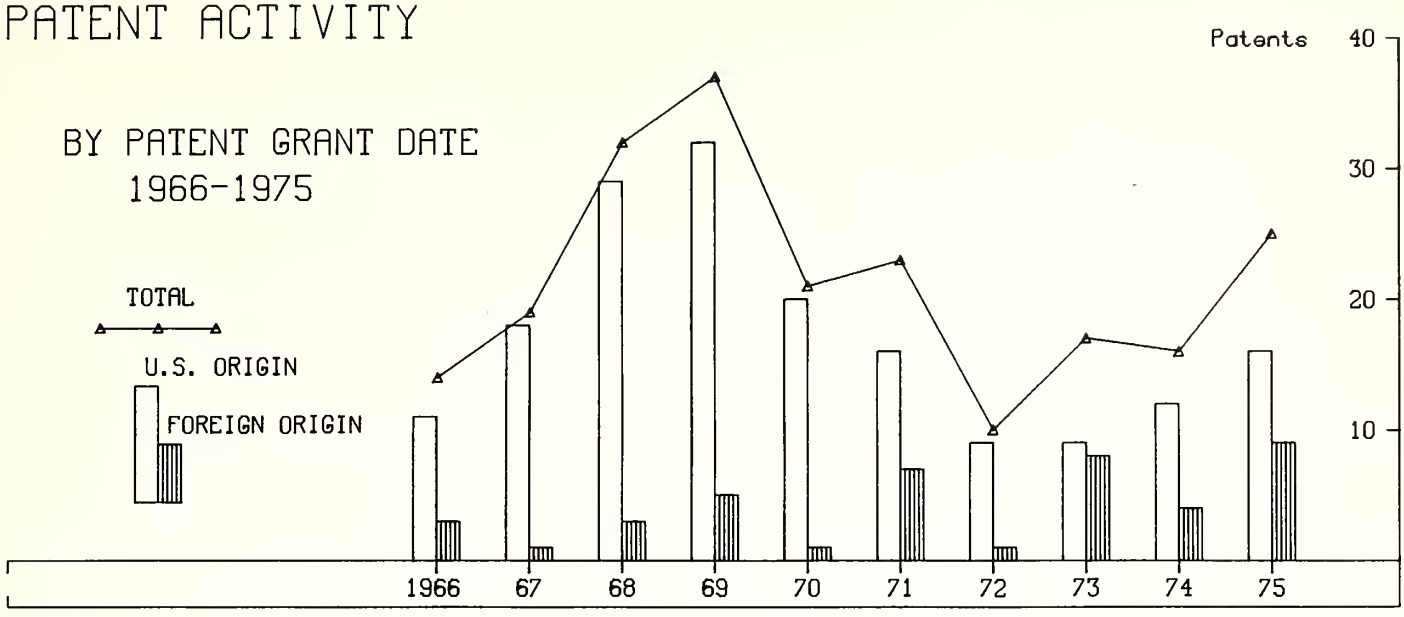
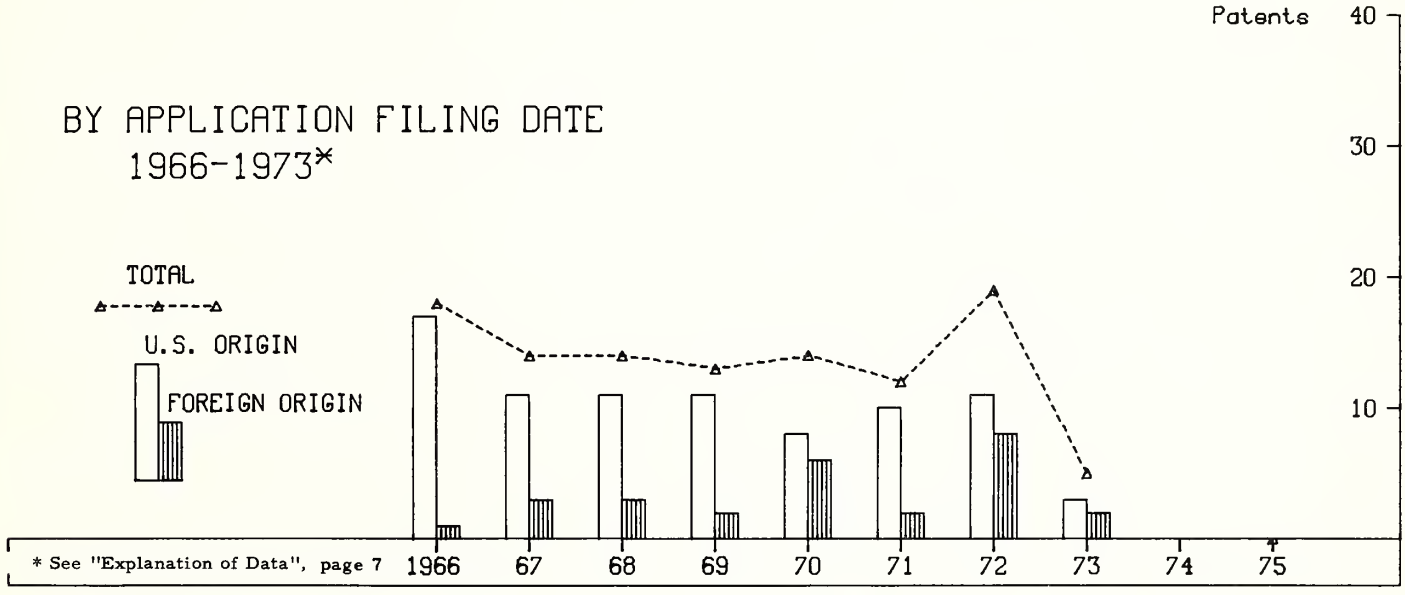
*See last paragraph on page 130

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	14	19	32	37	21	23	10	17	16	25	214	18	14	14	13	14	12	19	5	109
UNITED STATES	11	18	29	32	20	16	9	9	12	16	172	17	11	11	11	8	10	11	3	82
TOTAL FOREIGN	3	1	3	5	1	7	1	8	4	9	42	1	3	3	2	6	2	8	2	27
FRANCE	2		2	2		2		2	2	5	17		1			3	1	3	2	10
GERMANY						1	1	4	1	3	10		1	2	1	2	1	3		10
JAPAN				1	1	2		1			5	1			1	1				3
NETHERLANDS	1			1		1		1	1		5		1					1		2
UNITED KINGDOM		1				1				1	3			1				1		2
NORWAY			1								1									
USSR				1							1									

DIRECT CONVERSION TO MECHANICAL MOTION

This area includes systems which utilize thermal energy radiated by the sun to perform useful mechanical work directly. In general, these systems include a thermally expansible or vaporizable working fluid which is heated by solar radiation. The pressurized fluid thus produced is used to drive a fluid motor. (Selected patents from Class 60, subclass 641; Class 417, subclasses 53 and 379).

Average Annual Activity Indices (1973-75)

Growth*	11.9%	Corporate Owned	30.0%
Foreign Share	0.0%	Government Owned	0.0%

Recent Activity

Patent activity in this area includes use of solar energy to power turbines, air compressors, and to move fluids through a pipe line. Patents, issuing since October 1965, include:

3,213,284 (Lord, TRW, Inc.) - Discloses a friction-free mechanical linkage to rotate a rod connected to a solar energy concentrator. A pressure and temperature sensitive tube, twisted in a continuous S configuration, is attached to the rod and causes rotation in response to misaligned solar rays.

3,213,285 (McCusker, TRW, Inc.) - Discloses a solar concentrator using bi-metallic sensing strips for thermomechanical positioning.

3,234,738 (Cook) - Discloses a cyclic gas turbine power plant which uses solar heated water as a source of auxiliary heat.

3,287,901 (Tauer, Atmospheric Energy, Ltd.) - Discloses a heat operated power generator using solar energy to convert a low boiling media (e.g. liquid carbon dioxide) to a gas propellant for a turbine.

3,348,374 (Schalkowsky) - Discloses a sun referenced orienting device for positioning space vehicles. The device produces a torque which is proportional to the rate of change of angular misalignment with respect to the sun. Counter rotating radiometer effect is produced by the flow of gas molecules from a hot surface to a cold surface, striking an inclined vane during transit.

3,490,996 (Kelly) - Discloses an apparatus for lifting water (in vapor form from its source of supply to an elevated reservoir. A transparent duct runs up a hillside and solar energy heats the vapor carried inside.

3,654,759 (Abbot) - Discloses an apparatus which uses solar rays to heat air in a plurality of "black" enclosures. A series of valves are sequentially operated to direct heated air jets from the enclosures to a turbine wheel or a piston to obtain mechanical energy. The air in the enclosures is heated by dividing a reflected solar beam into a plurality of concentrated cones at each "black" enclosure.

3,659,960 (Dunlop, Creative Enterprises International) - Discloses use of solar energy to move fluids through a pipeline. Differential heating is supplied by the sun and check valves are used to prevent a reversal of the fluid upon reversal or discontinuance of the temperature gradient. A volatile fluid is mixed with the fluid being moved in order to create the desired pressure differential.

3,680,307 (Michalec) - Discloses a device for controlling the orientation of a platform with respect to the sun. The platform has a number of tanks attached to it containing a highly temperature sensitive fluid. Fluid vapor pressure is used to operate a piston connected to each tank to orient the platform. Shields are attached to the tanks to select the tank and the amount of solar energy required for platform orientation.

3,822,692 (Demarest) - Discloses a solar boiler to provide a constant source of pressurized gas for a power generator. A plurality of lenses are placed on each side of the boiler to direct solar energy at fluid carrying tubes within. A thermostatic or pressure sensing unit operates a lens shade to regulate the amount of solar energy used.

3,901,036 (Martin) - Discloses a solar boiler for powering fluid pressure motors. Two heat exchange mediums are used, oil and a hydrocarbon fluid. Solar energy heats the oil and, through the oil, a heat absorbing surface. This heat in turn is transferred to the hydrocarbon fluid whose resulting pressure is used to power a motor.

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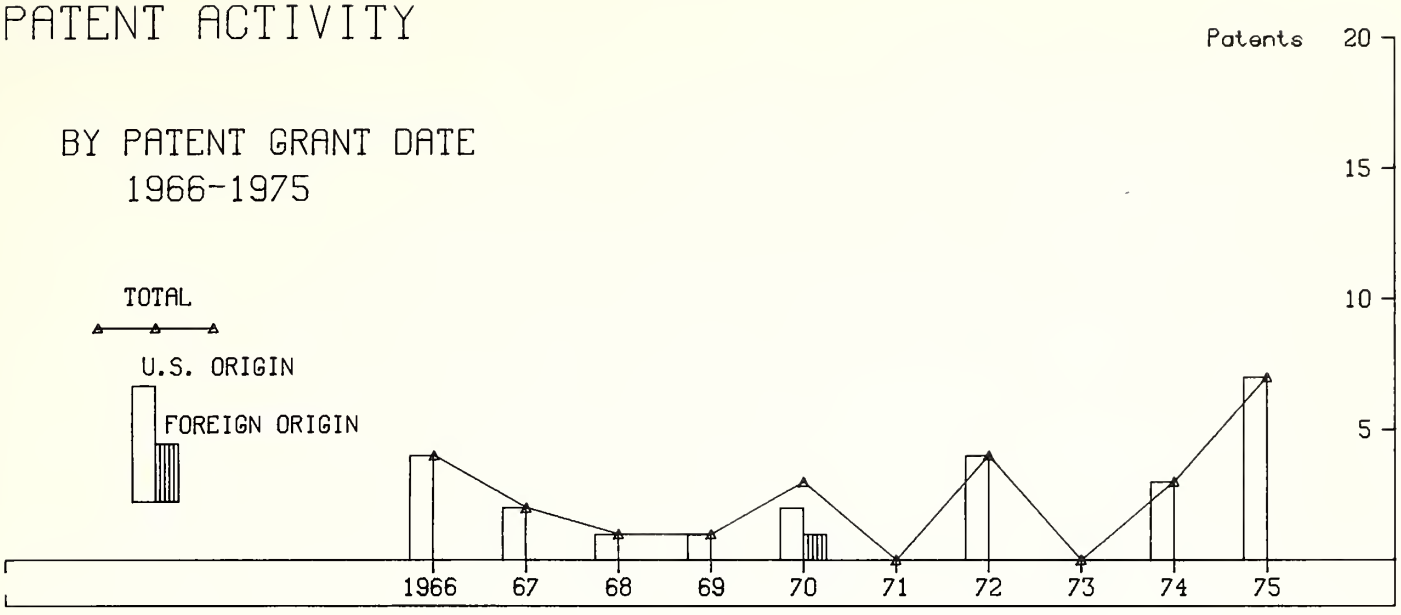
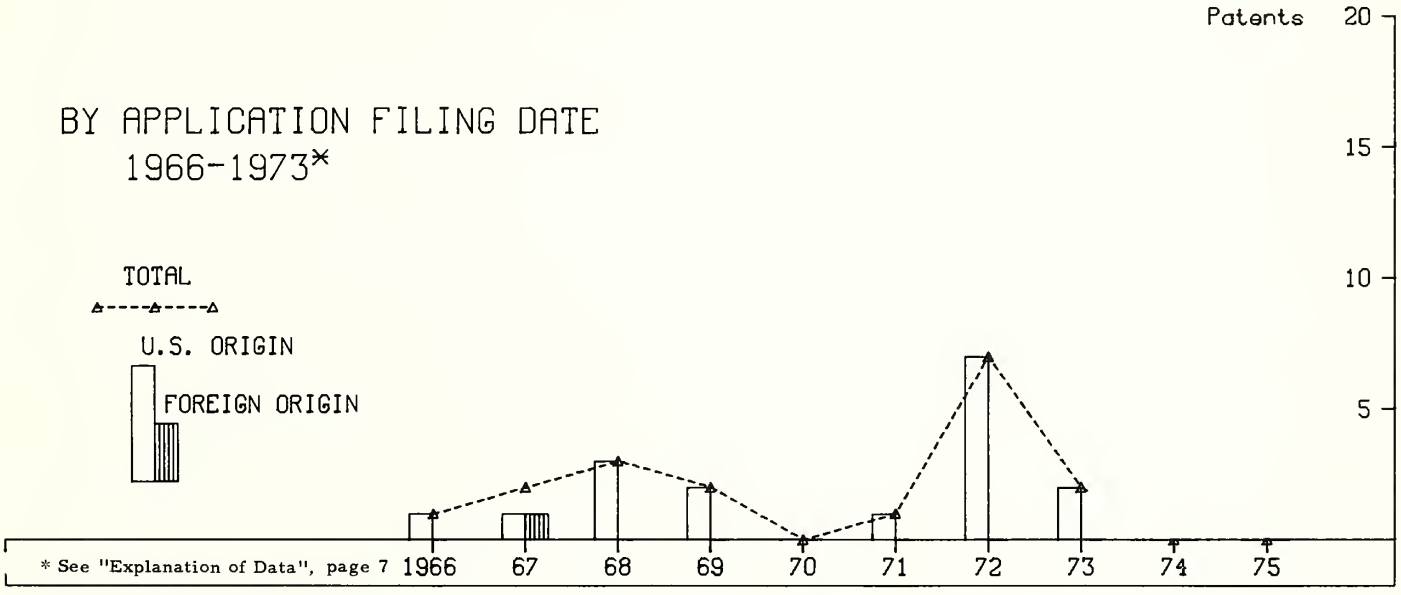
* See last paragraph on page 130

PATENT ACTIVITY

BY PATENT GRANT DATE
1966-1975



BY APPLICATION FILING DATE
1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	4	2	1	1	3		4		3	7	25	1	2	3	2		1	7	2	18
UNITED STATES	4	2	1	1	2		4		3	7	24	1	1	3	2		1	7	2	17
TOTAL FOREIGN					1						1		1							1
CANADA					1						1		1							1

SOLAR COLLECTORS AND CONCENTRATORS

This area relates to systems and elements which are intended to collect and/or concentrate solar radiation so that its energy may directly be used or converted to other forms of energy. The collector or concentrator element is usually in the form of a lens or a reflector. (Selected patents from Class 350, subclasses 211, 288-290, 292-296, 299 and 300)

Average Annual Activity Indices (1973-75)

Growth*	14.3%	Corporate Owned	63.2%
Foreign Share	15.8%	Government Owned	5.3%

Recent Activity

Recent patent activity includes reflectors for use in outer space, and a non-imaging solar collector and concentrator. Patents, issuing since January 1972, include:

3,635,547 (Rushing et al, Westinghouse Electric Corp.) - Discloses a large lightweight reflector for use in space. A thin flexible reflector membrane is stretched flat across radially projecting arms. The arms are permitted to be of relatively slender construction by virtue of a rigidizing system of guys.

3,713,727 (Markosian et al, Erevanskoe otdelenie Vsesojuznogo nauchno-issledovatelskogo proektnokonstruktorskogo i tekhnologicheskogo instituta kabelnoi promyshlennosti) - Discloses a parabolic solar energy concentrator with an energy receiver located at its focal point. The energy receiver accomodates a plurality of test objects and rotates to supply light pulses to each object.

3,717,879 (Ganssle, Noetec Corp.) - Discloses a collapsible reflector for deployment in space. A number of substantially rigid foldable panels covered with a reflecting surface are spaced around a central hub, and flexible reflecting material is located between adjacent panels.

3,781,095 (Rushing et al, Westinghouse Electric Corp.) - Discloses a solar reflector for use in outer space. A thin membranous reflector has a perimeter shaped in a series of inwardly curving arcs. A support cable runs along the perimeter. The reflector is stretched flat by support springs pulling at the junctions of the perimeter arcs. The perimeter cable is made to have a creep characteristic matching that of the reflector membrane to maintain flatness.

3,841,738 (Caplan) - Discloses an inexpensive, lightweight, parabolic solar reflector for reflecting incident solar radiation onto a fluid carrying conduit positioned along its focal axis. A rigid, waterproof, honeycomb panel formed from paper supports a reflective material, and glass fiber cloth on the outer surface adds strength and rigidity. The panels may be formed at or near the site of installation to obviate shipping problems.

3,869,199 (Cummings, Itek Corp.) - Discloses an optical amplifier for concentrating solar energy onto a conduit containing a fluid to be heated. The amplifier has an input end about 3/4 of an inch in width, an output end having a width of about 3/8 of an inch and reflective walls, positioned adjacent the conduit, that converge to the output end. The amplifier and conduit are insulated.

3,899,672 (Levi-Setti, The University of Chicago) - Discloses a non-imaging device for concentrating solar energy. The device has a generally conical-shape with inner reflective surfaces that guide and concentrate radiant energy from a large opening toward a relatively small exit where there may be a matched energy trap cavity.

3,902,794 (Abrams) - Discloses a fresnell lens that reflects, rather than transmits, light to its principal focus. This enables the separation of the thermal energy from sunlight, so that only the actinic light of the sunlight is passed on to solar cells.

3,912,380 (Klein, The Boeing Co.) - Discloses a reflective mirror having a concave honeycomb sandwich core and face plates. The sandwich carries a mirror base surface mounted on a felt isolator material having a low coefficient of expansion, low thermal conductivity, and uniformity of support.

3,923,381 (Winston, The University of Chicago) - Discloses a non-imaging solar collector and concentrator having longitudinally extending, generally trough-shaped inner reflective collection surfaces. The surfaces guide and concentrate radiant energy from a relatively large entrance toward a relatively small exit opening, where there may be an energy trap.

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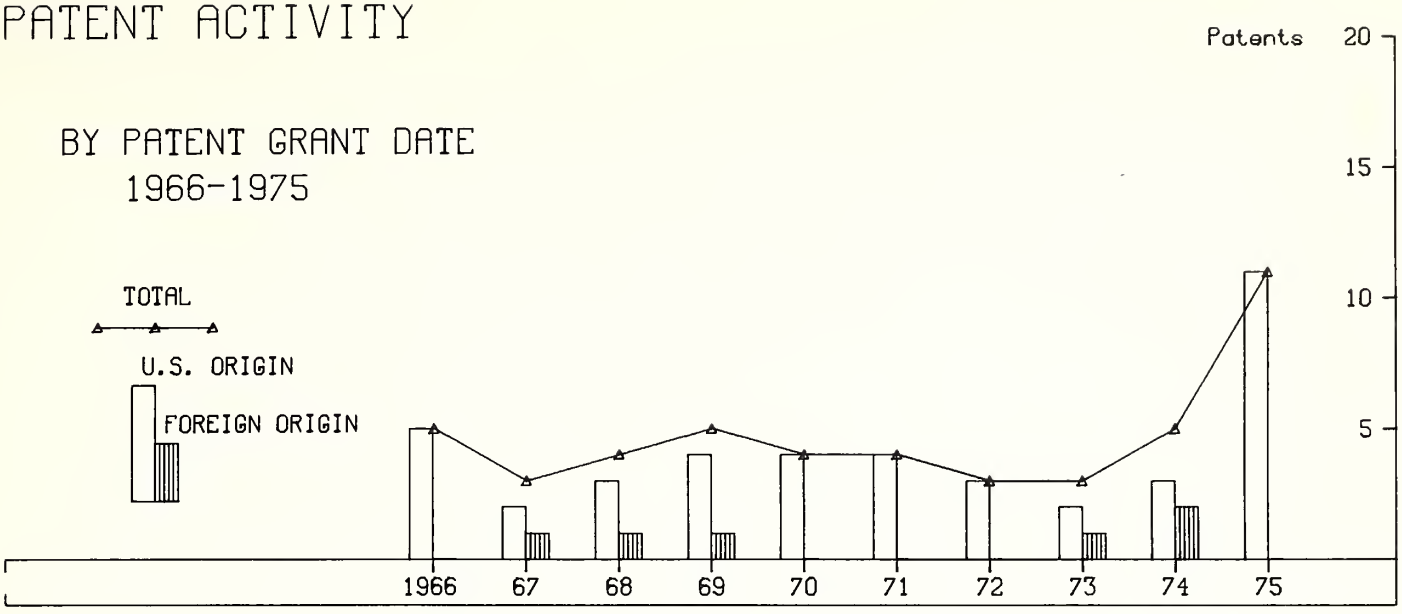
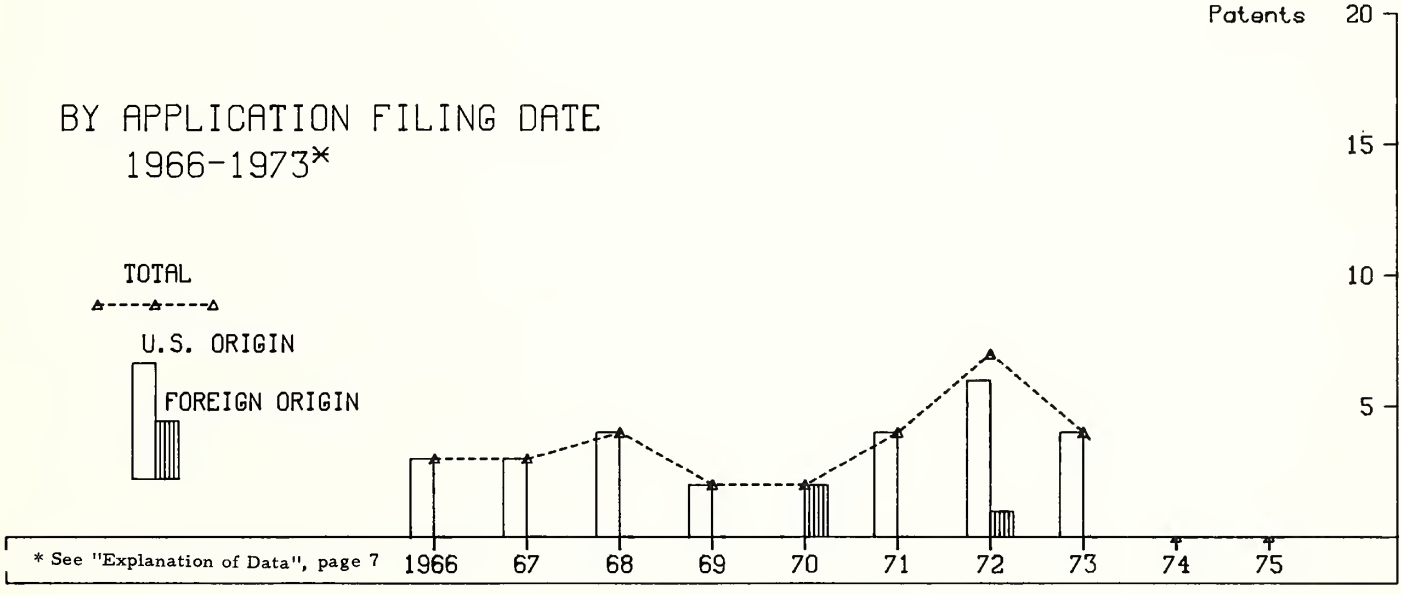
* See last paragraph on page 130

PATENT ACTIVITY

BY PATENT GRANT DATE
1966-1975



BY APPLICATION FILING DATE
1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	5	3	4	5	4	4	3	3	5	11	47	3	3	4	2	2	4	7	4	29
UNITED STATES	5	2	3	4	4	4	3	2	3	11	41	3	3	4	2		4	6	4	26
TOTAL FOREIGN		1	1	1				1	2		6					2		1		3
ITALY				1							1									
JAPAN									1		1					1				1
SWITZERLAND									1		1							1		1
GERMANY		1									1									
INDONESIA			1								1									
USSR								1			1					1				1

GEOTHERMAL AND OTHER NATURAL TERRESTRIAL HEAT ENERGY

This area relates to systems which are responsive to thermal energy obtained from natural terrestrial sources (earth and water) to generate power. Included are systems which derive power from geothermal heat sources or from temperature differentials in natural fluids as in various layers of sea water. (Selected patents from Class 60, subclass 641)

Average Annual Activity Indices (1973-75)

Growth*	46.6%	Corporate Owned	58.6%
Foreign Share	3.5%	Government Owned	0.0%

Recent Activity

Recent efforts in geothermal energy recovery have been mainly directed to systems for increasing the efficiency of recovery. In the recovery of heat energy from hot brine within the earth, systems have been developed which reduce the corrosive action of minerals in the brine on energy conversion equipment. Patents, issued since January 1975, include:

3,862,545 (Ellis et al, Chevron Research Company) - Discloses power generation system employing geothermal heat energy obtained from a hot brine well. The hot brine is flashed to form steam concentrated brine, and then fed to a turbine for electric power generation. The concentrated brine and steam from the turbine are combined to form a restored, cool brine which is returned to the brine well.

3,864,917 (Jacoby, International Salt Company) - Discloses a geothermal energy exchange system which employs the heat conducting capability of subterranean rock salt spires to carry heat from deep within the earth to a level where it is retrievable. A heat exchange reservoir cavity is excavated in a portion of the spire. Fluid pumped from the surface to this cavity absorbs the heat and then is returned to the surface for application to an energy exchanger.

3,874,174 (Greene) - A geothermal heat exchanger uses subterranean brine to provide electric power. A pair of spaced, sealed conduits, extending into a hot brine pool, are encased by respective housings. Brine, rising within one housing and descending within the other in a closed loop, volatilizes fluid injected in both conduits, producing steam under pressure. The steam is withdrawn, applied to turbines for power generation, and then condensed for reapplication to the conduits as injected fluid.

3,893,299 (Hutchison et al, Geothermal Investment Co.) - Discloses a system to recover geothermal heat by multiple flashing. Hot fluids from a geothermal well are passed through successive flash chambers operated at progressively lower temperatures and pressures. The steam from each flash chamber is used to superheat a working fluid, operating in a closed loop. Expansion of this hot working fluid in a power extracting device generates useable power.

3,896,622 (Daniello) - Discloses an electrical power generating system employing heat energy from tropical ocean waters. A housing containing a working fluid and piston is lowered into the water from a barge. Heat energy from the water boils the working fluid to raise the piston within the housing to a higher level where it is latched in place. The housing is then caused to sink to colder depths causing the working fluid to condense. At completion of condensation, the latch is released and the piston drops. Energy released by the dropping piston is converted to electrical power.

3,910,050 (Matthews et al, Sperry Rand Corp.) - Discloses a system to produce electrical power from pressurized hot solute-bearing well water. Hot well water converts clean water injected into the well into steam which is used to power a turbine-driven pump at the well bottom. Solute-bearing well water is forced at high pressure to the earth's surface and fed to a closed loop boiler-turbine-alternator combination to generate electrical power.

3,914,683 (Wolf) - Geothermal heat is transferred from either dry or wet subterranean strata to a location at or near the earths surface by a passive heat pipe extending into a well. The upper end of the heat pipe extends into a steam chamber where water is converted to steam and used to drive a turbine generator or the like. Spent steam is condensed and recycled.

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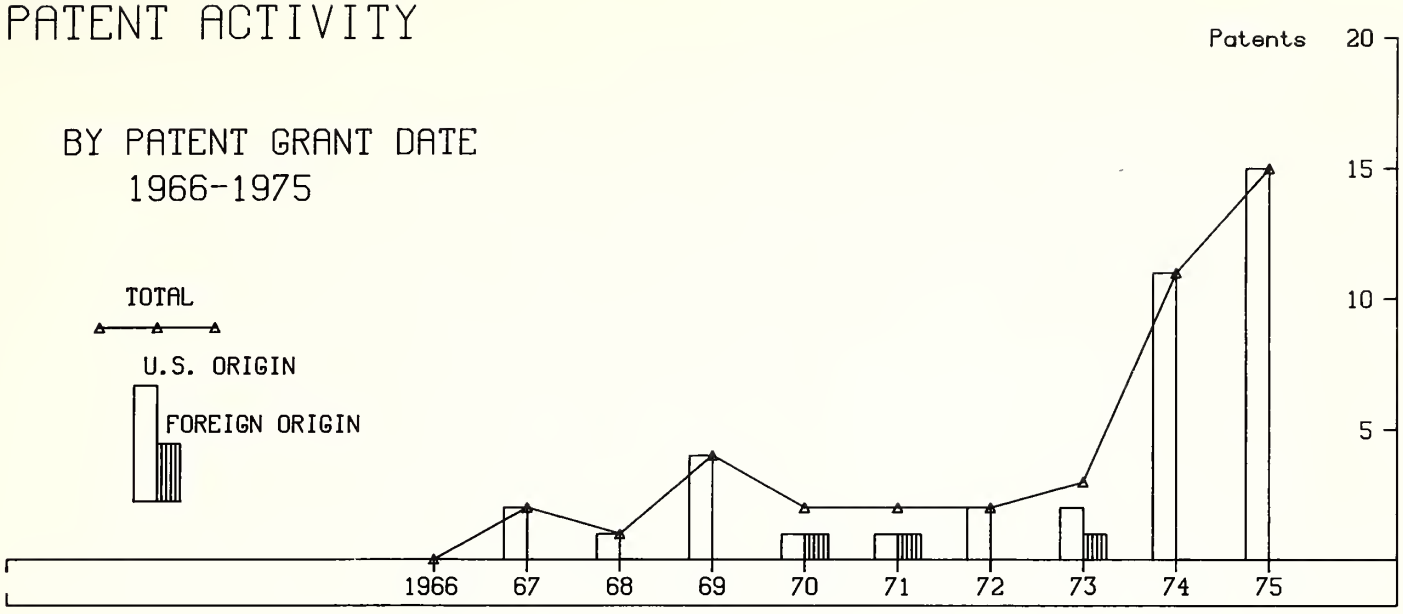
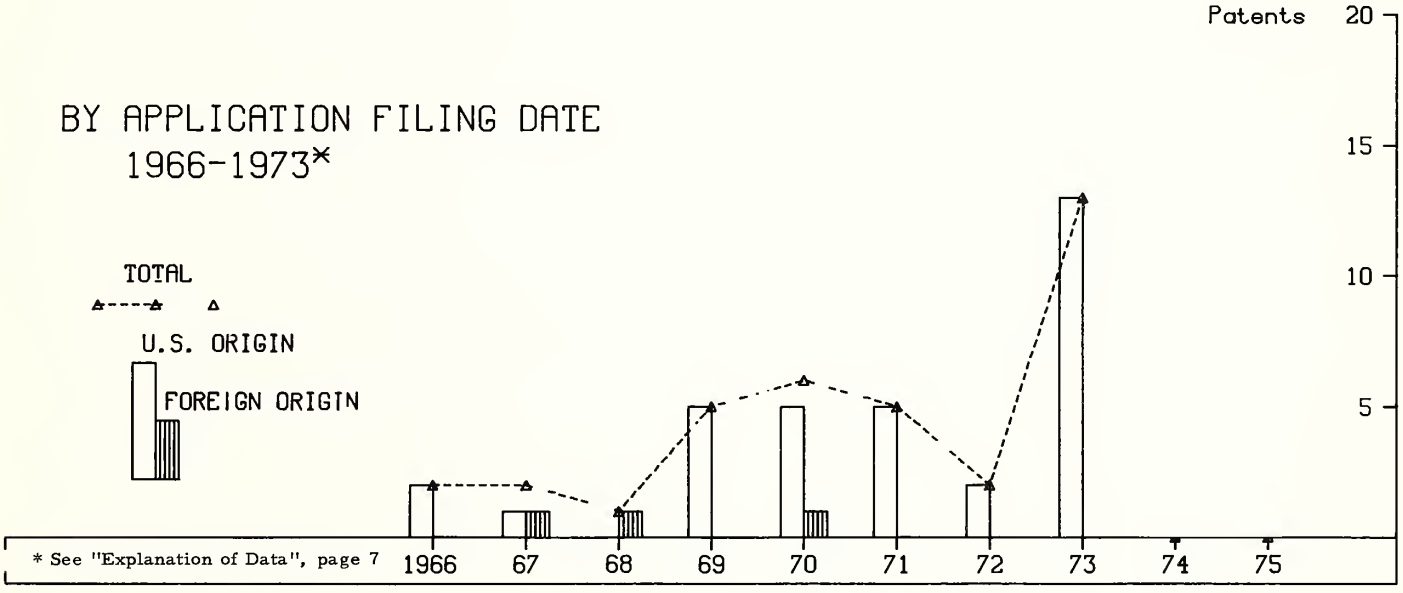
* See last paragraph on page 130

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS		2	1	4	2	2	2	3	11	15	42	2	2	1	5	6	5	2	13	36
UNITED STATES		2	1	4	1	1	2	2	11	15	39	2	1		5	5	5	2	13	33
TOTAL FOREIGN					1	1		1			3		1	1		1				3
CANADA								1			1					1				1
PHILLIPINES					1						1		1							1
JAPAN						1					1			1						1

TIDE AND WAVE ENERGY

This area includes systems which utilize the energy of tidal or wave motion in large unconfined bodies of water. The systems included rely almost exclusive on the periodic vertical component of the fluid motion to do work. That is, these systems operate by converting the relatively rapid periodic rise and fall of the water into reciprocating mechanical motion by means of a buoyant member. This mechanical motion is then utilized to perform the desired task. Not included are systems which artificially confine bodies of water, such as tidal-storage type hydroelectric systems. (Class 60, subclasses 495-507; Class 290, subclasses 42, 53; Class 417, subclasses 330-333)

Average Annual Activity Indices (1973-75)

Growth*	10.6%	Corporate Owned	12.5%
Foreign Share	15.6%	Government Owned	0.0%

Recent Activity

Recent efforts generally appear directed toward more efficient conversion of tide and wave energy to mechanical motion by providing better motion sensors and preventing binding between the float and frame structures. Systems designed to withstand violent ocean movements in all directions also appear to be a subject of current interest. Patents, issued since August 1974, include:

3,828,557 (Mochel, Ocean Power Generation Inc.) - An electrical power generating plant converts the pushing action of waves into electricity. Tee heads mounted at the ends of extended booms respond to the pushing action of the waves and are later made transparent to such action on return to the extended position. The booms are supported by an onshore structure which includes a drive shaft rotated by the booms and connected through flywheel action to an electrical generator.

3,870,893 (Mattera) - A wave operated power plant employs a buoyant vessel anchored to the ocean floor. Water is forced by wave motion through pipes in the vessel hull and into a housing which contains blades attached to a shaft driving an electrical generator.

3,879,950 (Yamada) - An offshore electric power generating plant employs the use of compressed air to supplement superheated steam for power generation. During non-peak electricity usage, compressed air is produced by coupling air compressors to vertically moving floats on the ocean surface. This air is stored and later heated and mixed with superheated steam for increased power production needed to handle peak periods of consumption.

3,911,287 (Neville) - Discloses a wave motion to electrical energy converter. A float is mechanically coupled to a pair of sprocket wheels capable of rotating clockwise or counterclockwise in response to up or down float displacement. Respective chains link the sprockets to corresponding one-way clutches allowing the generation of rotory motion in one direction only. This motion is used to run an alternator that generates electricity.

3,918,260 (Mahneke) - Discloses a pumping apparatus powered by the rise and fall action of the waves. A pair of floats are interconnected by a chain which straddles a pair of spaced pulleys anchored to the ocean floor. Wave motion advances the chain and pulleys alternately in opposite directions. A pump has a piston coupled to one of the pulleys to pump fluid to an outlet port in response to the wave motion.

3,918,261 (Bailey) - Discloses a wave and tide motor having an operating lever pivoted at its center with a float at one end for immersion in water and a vertically moving elongated channel shaped member connected to its other end by a lost-motion connection. A rack, secured to the member, is in meshing engagement with a pinion having a shaft connectable to a suitable electric power generator to provide electricity in response to wave and tide motion.

3,922,739 (Babintsev) - A device to convert sea wave energy to electrical energy employs a buoy on which an air turbine generator is mounted. A large conduit or pipe connected to the turbine is partially submerged in the water. The water, due to wave motion, rises and falls in the conduit and acts as an hydraulic piston forcing air past the turbine blades to cause rotary motion which is converted to electrical energy.

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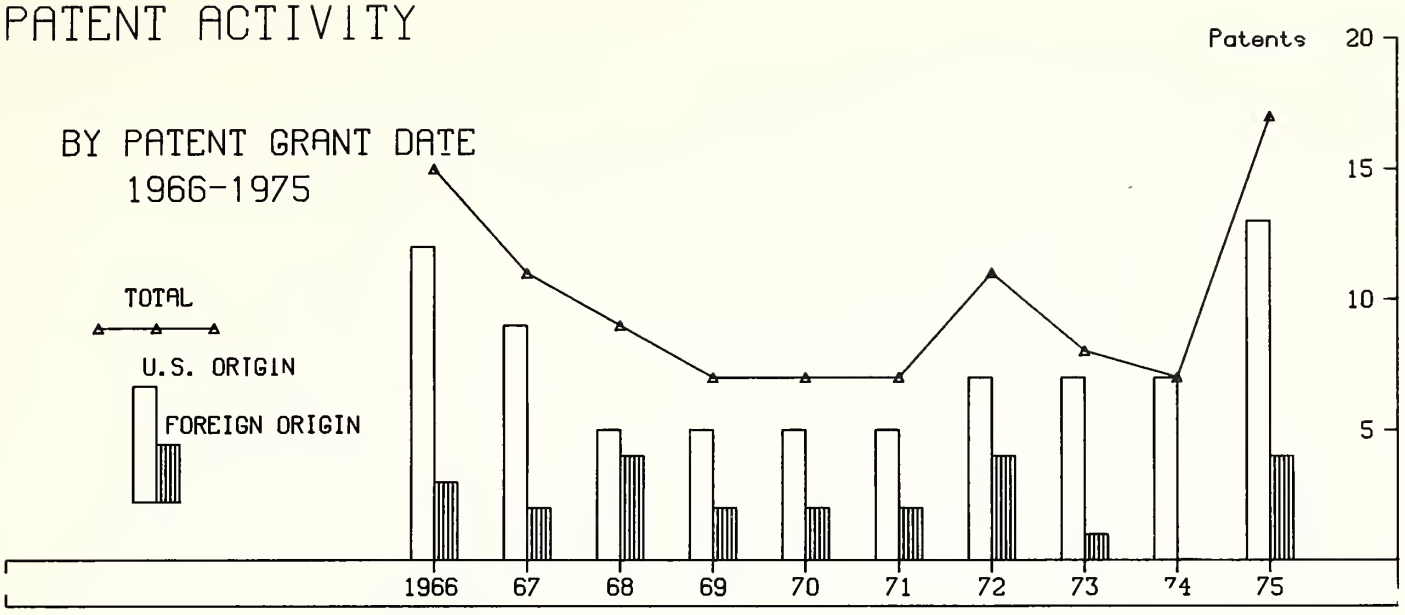
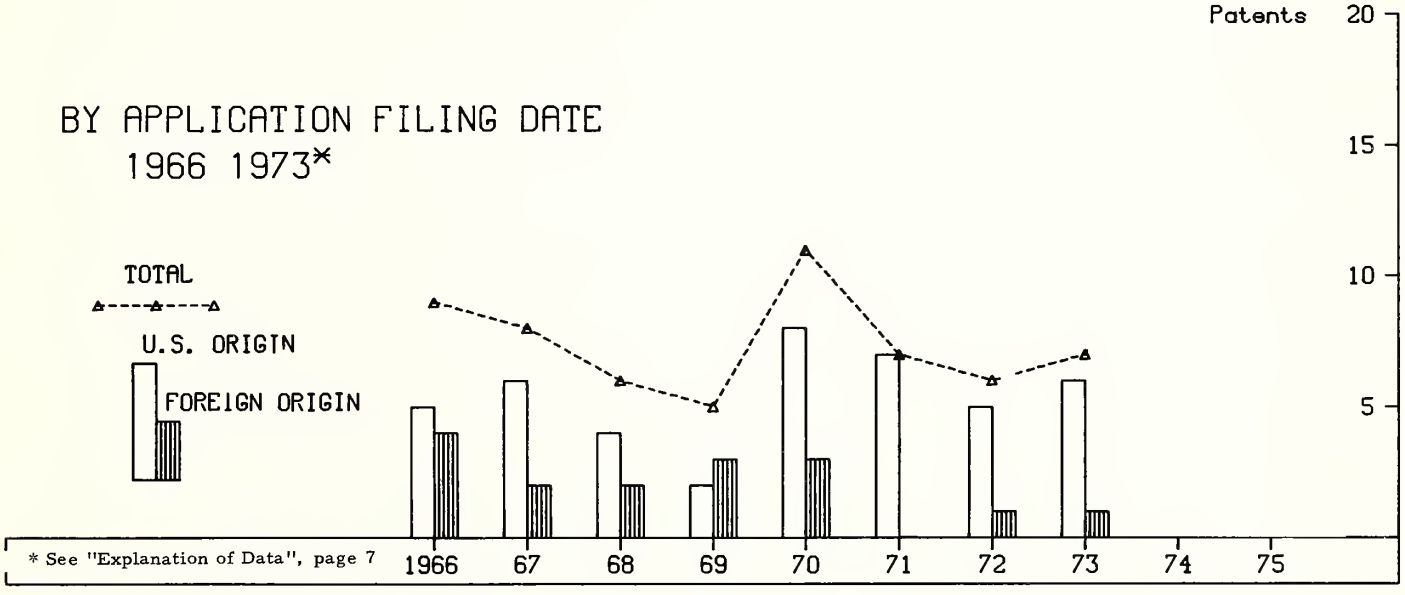
* See last paragraph on page 130

PATENT ACTIVITY





* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	15	11	9	7	7	7	11	8	7	17	99	9	8	6	5	11	7	6	7	59
UNITED STATES	12	9	5	5	5	5	7	7	7	13	75	5	6	4	2	8	7	5	6	43
TOTAL FOREIGN	3	2	4	2	2	2	4	1		4	24	4	2	2	3	3		1	1	16
SWITZERLAND			2		2						4	2		2						4
UNITED KINGDOM	1						1	1		1	4					1		1		2
GERMANY		1	1	1							3	1	1							2
JAPAN		1								1	2								1	1
CANADA						1	1			1	3				1	1				2
MEXICO	2										2									
USSR							1			1	2					1				1
SWEDEN						1					1				1					1
FRANCE							1				1				1					1
ALL OTHER (3)			1	1							2	1	1							2

HOT WATER OR STEAM PRODUCTION FROM WASTE MATERIALS

Structures which employ a furnace and a liquid heater or vaporizer to provide energy in the form of hot water or steam from garbage and sewage waste. Usually, combustion occurs in two stages. In the first stage a primary fuel source is burned to provide a level of heat necessary for subsequent complete combustion of the waste during a second stage. (Class 110, subclass 10; Class 122, subclass 2)

Average Annual Activity Indices (1973-75)

Growth*	20.2%	Corporate Owned	54.6%
Foreign Share	36.4%	Government Owned	0.0%

Recent Activity

Recent patent activity is directed mainly to structures to improve efficiency by providing, from a given unit of waste material, more energy transfer to the hot water or steam. Patents, issued since December 1972, include:

3,706,288 (Peterson, Garbalizer Corp. of America) - Discloses a system for electric power generation utilizing combustion of waste materials. High temperature gases, resulting from complete combustion of waste, produce steam which is directed to a turbine for the generation of electric power. Complete combustion of waste is accomplished in a two-step process. First, waste is added to a high temperature coal-type furnace. Combustible gases produced both from the coal and waste material are then completely burned in a second chamber or furnace.

3,756,201 (Williams, G. W. B. Boilers Limited) - Discloses an industrial boiler, having a combustion chamber and fuel feeder which utilizes "wood waste" (saw dust, wood chippings, etc.) for fuel. Oil, supplied to the chamber, is burned to allow temperatures to rise to a first level and thereafter to a second level. A timer and control system then gradually substitutes "wood waste" for oil while maintaining constant temperature until only "wood waste" is combusted.

3,822,651 (Harris) - Discloses a combined rotary kiln and furnace to provide combustion of large and small waste material. A cylinder shaped kiln, composed of a large number of water carrying pipes, rotates while being fed combustible waste. A heat exchange system provides water to the pipes and removes steam formed from combustion heat. A furnace, coupled to the kiln, provides combustion of large size waste materials incompletely burned by the kiln and generates additional steam through the same heat exchange system.

3,858,534 (Berg, Interstate Utilities Corporation) - Discloses a system for garbage disposal and concurrent electric power generation. A primary heat source of low grade fuel oil and a secondary heat source of garbage and refuse are fired in a heat insulated cupola-type furnace at temperatures high enough to completely combust all organic matter and melt all inorganic matter. The hot combustion gases produce steam which in turn is used to generate electric power. Noxious gases and particulate solids are removed from spent effluent before it is exhausted to the atmosphere.

3,861,334 (Stockman, The Air Preheater Company, Inc.) - Discloses an incinerator which recovers the heat energy from hot gas resulting from combustion of waste materials. The hot gas is fed to a waste heat boiler where heat energy is recovered and cooled gas is produced. A portion of this cooled-down gas is mixed with the hot combustion gas prior to being fed to the waste heat boiler.

3,861,336 (Koyanegi) - Discloses a rotary kiln garbage incinerator having combustion and flue chambers and an internal preheating cylinder that rotates with the chambers. Garbage, placed in the cylinder through a chute, is preheated in the cylinder before entering the combustion chamber to be burned. Hot flue gases from the combusted garbage raise the temperature of a surrounding water jacket to provide useful heat energy.

3,918,373 (Fritz et al, Andco Inc.) - Discloses a solid waste disposal system, having primary and secondary combustion chambers which produces useable heat. Air to effect combustion is preheated by waste gas via a heat exchanger. The remaining waste heat is passed to a boiler or other means for utilizing the thermal energy contained therein.

3,926,130 (Stloukal et al, Prvni Brnenska strojirna) - Discloses an enclosed incinerator useful to produce electric power for a hospital from hospital waste. The incinerator employs an auxilary chamber coupled between a grate combustion chamber and a boiler. The boiler converts heat from the hot effluent to steam.

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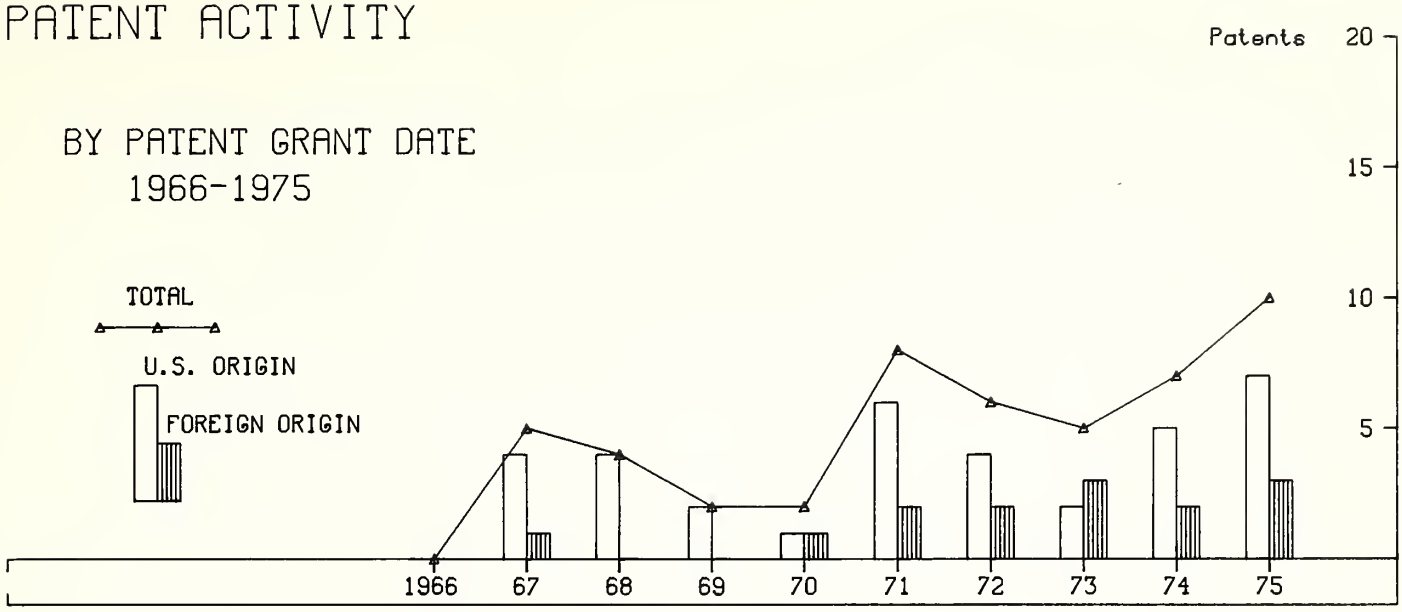
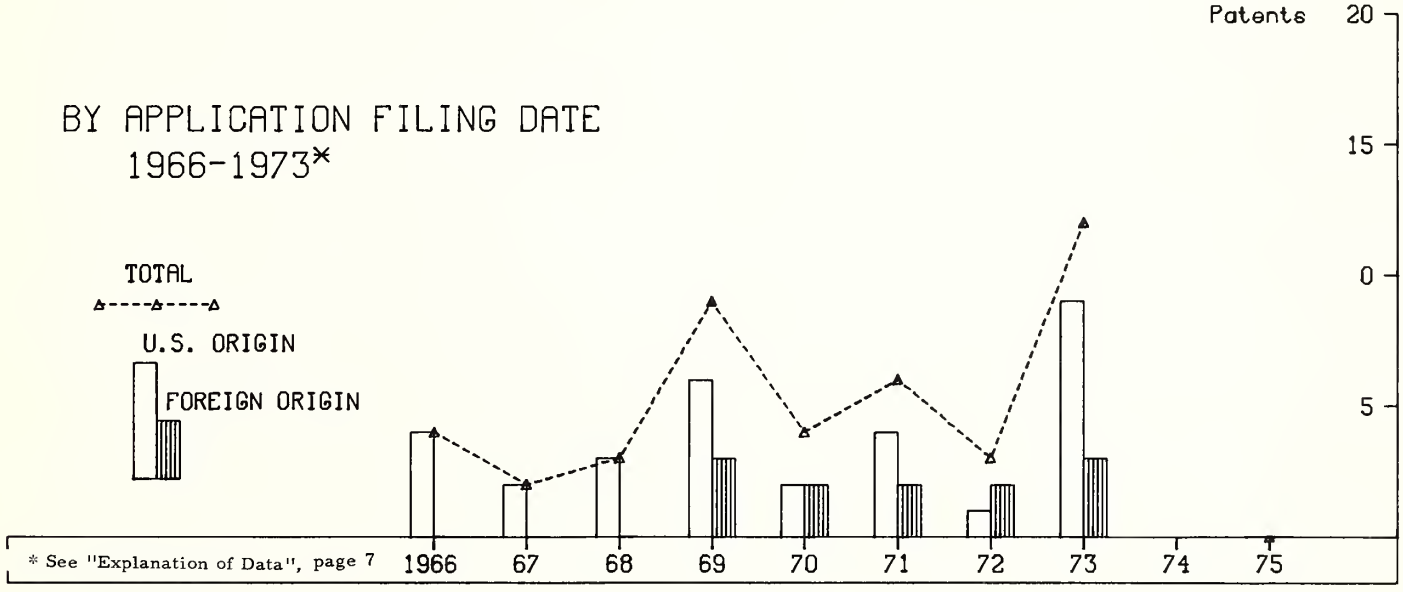
* See last paragraph on page 130

PATENT ACTIVITY

BY PATENT GRANT DATE
1966-1975



BY APPLICATION FILING DATE
1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS		5	4	2	2	8	6	5	7	10	49	4	2	3	9	4	6	3	12	43
UNITED STATES		4	4	2	1	6	4	2	5	7	35	4	2	3	6	2	4	1	9	31
TOTAL FOREIGN		1			1	2	2	3	2	3	14				3	2	2	2	3	12
JAPAN					1		1	1	2	2	7				1	1	1	1	3	7
GERMANY						2					2				2					2
SWITZERLAND							1				1					1				1
UNITED KINGDOM								1			1						1			1
MEXICO		1									1									
CANADA								1			1							1		1
CZECHOSLOVAKIA										1	1									

PRODUCTION OF FUEL FROM WASTE MATERIAL

Apparatus and methods for the production of useful fuels from waste material. Gaseous fuels (e.g. methane), liquid fuels (e.g. synthetic oil) and solid fuels (e.g. fireplace logs and briquets) are manufactured from municipal and industrial waste such as garbage, vegetable waste (e.g. wood and other cellulosic material), plastic waste, crop waste (bagasse, corn stalks etc.), and other refuse. (Class 48, subclasses 76, 111, 197R, 197A, 202, 203, 206, 209, 215; Class 44, subclasses 1R, 1D, 1E, 2, 10R, A, B; Class 201, subclasses 2.5, 21, 25)

Average Annual Activity Indices (1973-75)

Growth*	31.1%	Corporate Owned	79.3%
Foreign Share	17.2%	Government Owned	3.5%

Recent Activity

Recent patent activity is directed toward improving the efficiency of waste conversion to fuel; increasing the energy content of the fuel produced; and, producing cleaner burning fuels. Patents, issued since February 1973, include:

3,718,446 (Brink etal, The Regents of the University of California) - A process of manufacturing a clean burning gaseous fuel from the kraft black liquor waste of a wood pulping operation. High temperature distillation and pyrolysis breaks down the liquor into non-combustible solids and a stable clean burning fuel gas. Malodorous gaseous emissions of the pulping operation supply an amount of oxygen sufficient for the pyrolysis but not for complete combustion of the liquor.

3,736,111 (Gordner et al, Hercules Incorporated) - A process for the recovery of valuable products including fuel gas from domestic and industrial refuse. Domestic refuse is subjected to aerobic digestion and then separated into a humus product, and organic and inorganic non-digestible materials. The organic non-digestible material is combined with industrial refuse and pyrolyzed to fuel gas.

3,820,965 (New) - Smoke stack gases that are normally wasted are processed along with hydrogen generated from waste water or sea water to provide useful fuel and other useful products. Carbon dioxide and other components are recovered from the smoke stack gases. Hydrogen from waste or sea water is delivered with the carbon dioxide to a sabatier catalytic reaction chamber which produces methane gas, potable water, and other useful by-products.

3,852,048 (Pyle, The Kingsford Company) - Industrial solid and gaseous fuels are produced from woody waste material (bark, twigs, sawdust, peanut shells etc.) which contains large quantities of moisture. A two-step process of partial drying and carbonization is employed which achieves an optimum flow rate of gas to maximize formation of fuels and minimize formation of condensable liquids during pyrolysis.

3,853,498 (Bailix) - Municipal waste is converted to high energy fuel gas by fluidized bed pyrolysis. Heat required for the reaction is supplied by hot fluidized inert solids transferred to the pyrolysis zone from a combustion zone. Absence of oxygen allows the cellulosic content of the waste to "explode", rather than burn, yielding pyrolysis gas containing methane, carbon dioxide, hydrogen, carbon monoxide and water vapor.

3,864,097 (Urban, Universal Oil Products Company) - A process for converting cellulose components of municipal waste into liquid hydrocarbonaceous products. The cellulose components are converted to fuel oil in the presence of water, a reducing gaseous mixture of carbon monoxide and hydrogen, a catalytic compound containing sulfur, and an alkali metal or ammonium ion.

3,880,611 (Weiss) - Artificial fireplace logs are formed from a combination of raw sawdust and Northern Kraft paper beater stock, eliminating the need for a chemical binder for the sawdust. The sawdust and beater stock are mixed thoroughly with water in a tank while a felting screen is lowered into the tank. Suction draws the mixture onto the screen until a uniform layer is built up. Minute fiber tentacles of the Kraft paper hold the sawdust together firmly, allowing removal of the screen from the tank, release of suction, and subsequent drying and packaging of the log.

3,907,519 (Greg et al, Chevron Research Company) - Waste is converted to a hot gaseous stream by a series of processes including H_20 distillation, oil distillation, pyrolysis and gassification. After quenching and water scrubbing, a portion of the hot gaseous stream is combusted, methanated and recycled to the gassification reaction chamber to provide higher B.T.U. content gas.

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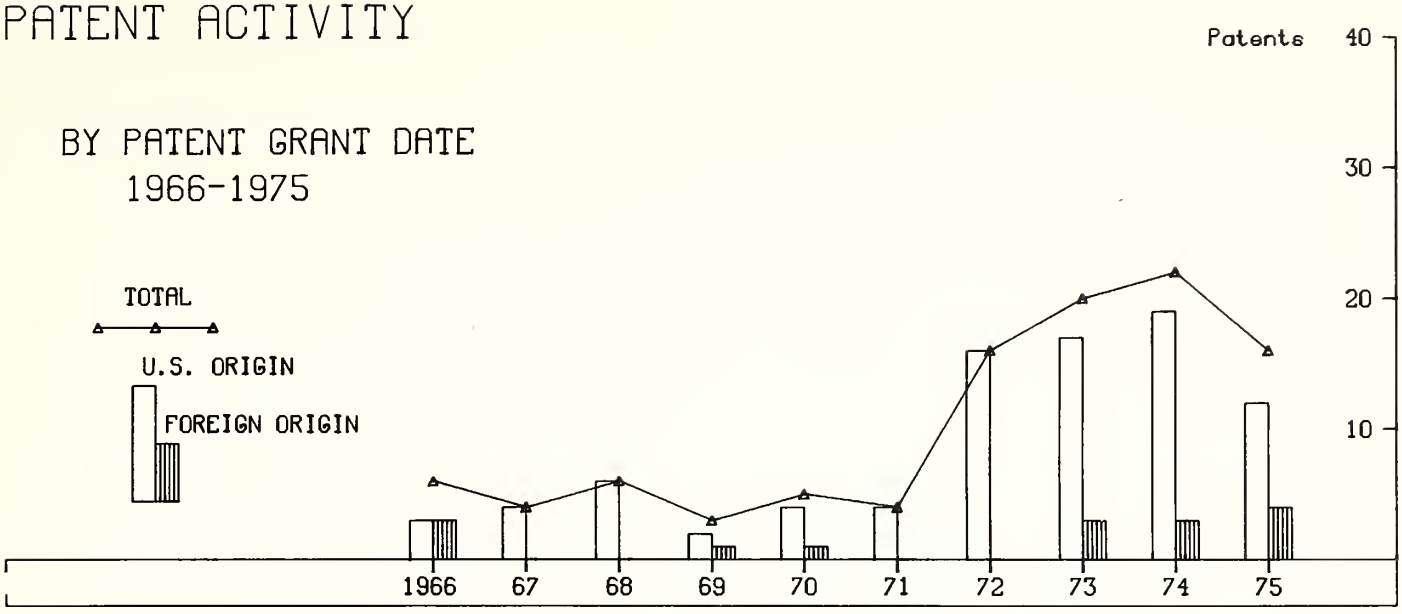
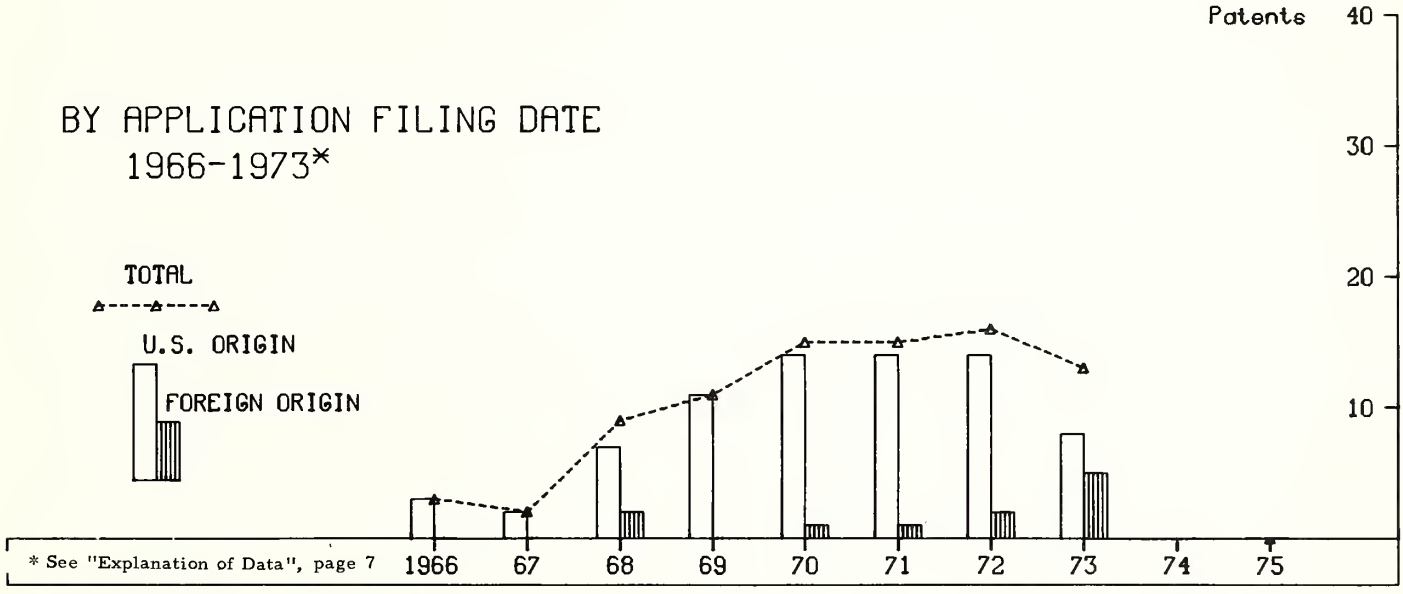
* See last paragraph on page 130

PATENT ACTIVITY

BY PATENT GRANT DATE
1966-1975



BY APPLICATION FILING DATE
1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	6	4	6	3	5	4	16	20	22	16	102	3	2	9	11	15	15	16	13	84
UNITED STATES	3	4	6	2	4	4	16	17	19	12	87	3	2	7	11	14	14	14	8	73
TOTAL FOREIGN	3			1	1			3	3	4	15			2		1	1	2	5	11
JAPAN					1				2	2	5			1				1	3	5
CANADA	2							1			3			1						1
DENMARK				1				2			3					1	1			2
SWEDEN										1	1								1	1
GERMANY									1	1	2							1	1	2
UNITED KINGDOM	1										1									

ELECTRICITY GENERATED BY WIND *

Introduction

Harnessing the wind to do work is very old; and, harnessing the wind to generate electricity, while certainly far more recent, is among the oldest of methods. Yet, for technical/ economic reasons, this method was generally by-passed in the development of electrical generation technology.

However, the soaring costs of traditional energy sources has stimulated a broader interest in this field -- an interest which has been mirrored in an increase in patent activity. Comparing the patenting during the last three years (1973-1975) against the base of patenting during the preceeding decade (1963-1972), the growth of this technology has averaged 30.4%, or almost 3 times the average for all technologies combined. Foreign resident inventors have had no share of this growth. In fact, in this technology, only one U.S. patent in the last ten years has been granted to a foreign inventor.

The growth and distribution of the U.S. patents issued in the area during the ten year period 1966-1975 is shown in the graphs and table on the next page.

Development of the Technology

The technology considered in this report is focused on the use of a wind driven motor to convert wind energy into mechanical movement to power (directly or indirectly) a generator of electricity.

As noted previously, the basic structures used to capture wind power are old. Some of the earliest U.S. patents were in this field. For example, Patent No. 7,470 (issued March 8, 1833) shows a drum type wind-wheel rotating on a vertical axis and encircled by a number of doors which regulate the amount of wind allowed to strike the wheel.

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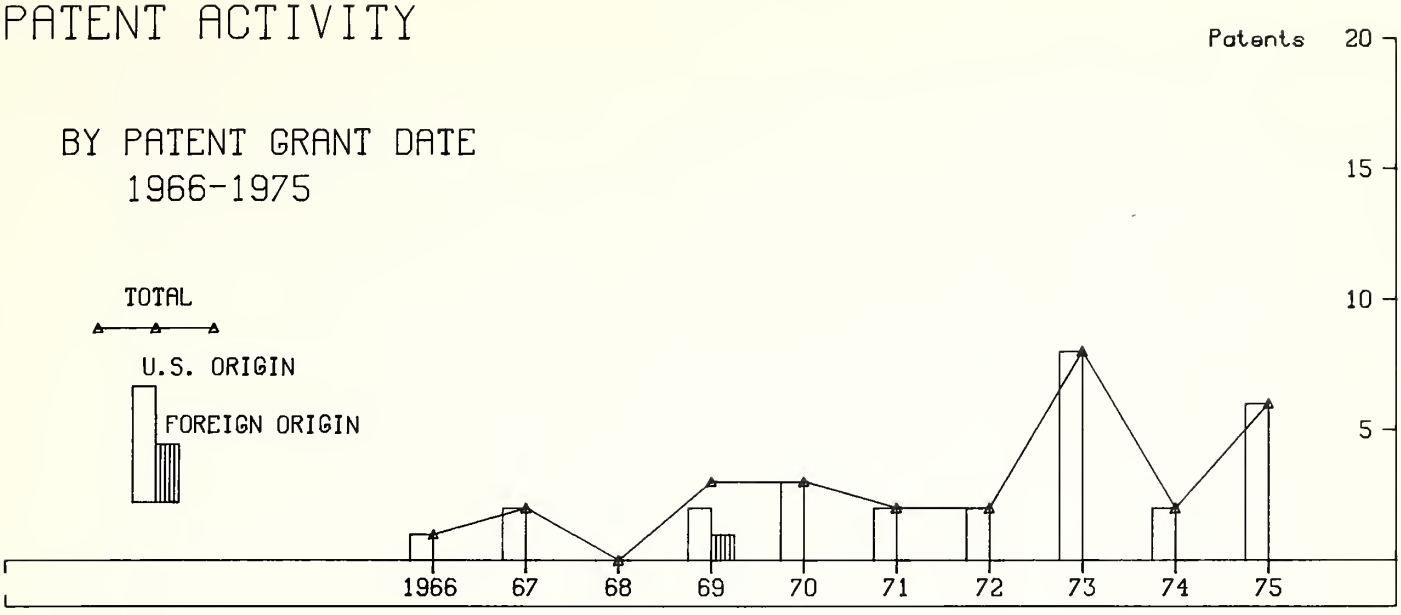
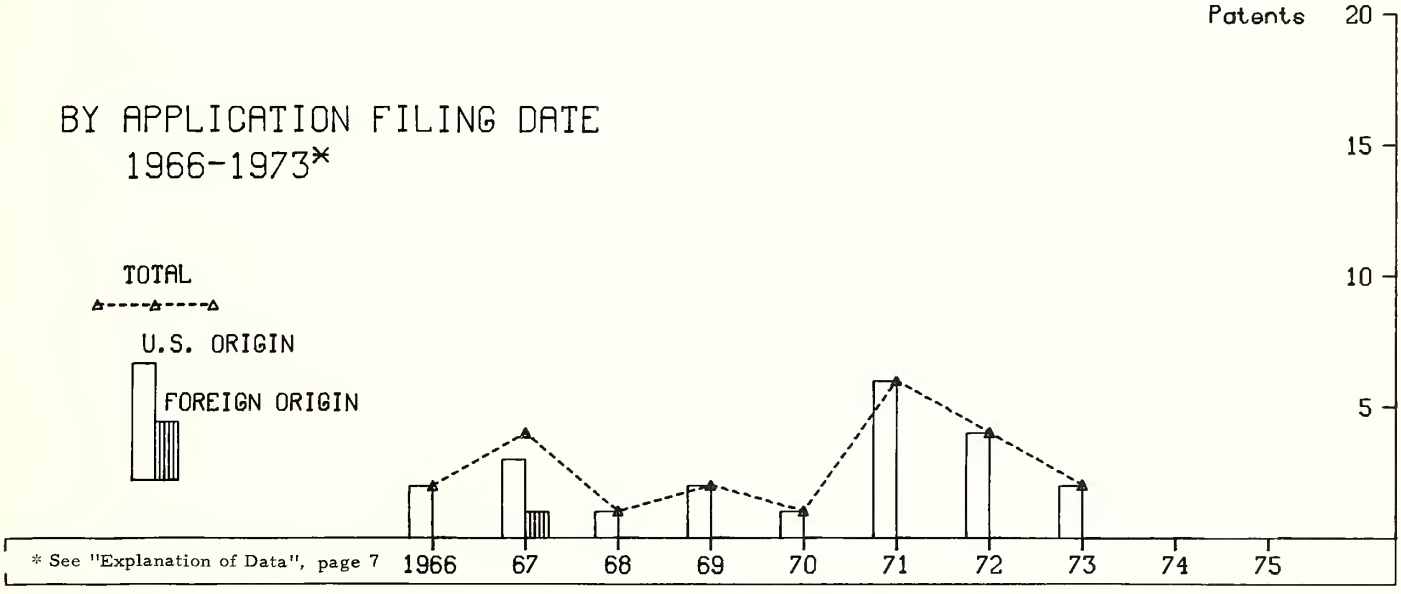
* The technology described and the statistics presented in this report relate primarily to Patent Classification System Class 290, subclasses 44 & 55. Also considered and included in the discussion are patents selected from Class 60, subclasses 398 and 698; Class 244, subclass 58; Class 415, subclasses 3, 4 and 5; and, Class 416, subclass 37.

PATENT ACTIVITY

BY PATENT GRANT DATE
1966-1975



BY APPLICATION FILING DATE
1966-1973*



* See "Explanation of Data", page 7

DISTRIBUTION OF PATENTS IN AREA OF INTEREST

	BY PATENT GRANT DATE											BY PATENT APPLICATION FILING DATE								
	1966	67	68	69	70	71	72	73	74	75	TOTAL 66-75	1966	67	68	69	70	71	72	73	TOTAL 66-73
TOTAL PATENTS	1	2		3	3	2	2	8	2	6	29	2	4	1	2	1	6	4	2	22
UNITED STATES	1	2		2	3	2	2	8	2	6	28	2	3	1	2	1	6	4	2	21
TOTAL FOREIGN				1							1		1							1
GERMANY				1							1		1							1

U.S. patenting in basic concepts of converting wind energy to electricity are also old. U.S. Patent No. 569,754 (issued October 20, 1896) discloses a windmill used with two water tanks. One tank is pressurized by the windmill. Water flowing to a second, unpressurized tank operates a water-motor. The water-motor generates electricity which is stored in batteries. This patent also acknowledges techniques of storing energy in fly-wheels, in compressed air to operate an air-motor, and by pumping water to an elevation to operate a water-motor by falling back.

U.S. Patent No. 641,957 (issued January 23, 1900) shows a windmill which mechanically drives a dynamo for providing energy to electric lights in "suburban homes and farm-houses". Use of a storage battery is also mentioned. U.S. Patent No. 665,810 (issued January 8, 1901) discloses a sail powered platform on wheels. Electric generators are connected to the wheels which run on a circular track. A motor is used to drive the platform in the absence of wind-power. This last approach is similar to a recent experimental project, using a five-mile circular track at Montana State University, funded by the National Science Foundation .

The first wind generator of electricity for commercial purposes in the United States was the Smith-Putnam wind turbine, located in Vermont in the early 1940's. The machine consisted of a large two blade rotor mounted on top of a tower. The electric generators were mounted in a housing directly behind the rotor. This machine was phased-in to the lines of the Central Vermont Service Corporation on October 19, 1941 and operated until a blade failure on March 26, 1945. The unit was rated at 1,000-kilowatts and was very similar to the 100-kilowatt experimental unit recently built by the U.S. Government near Sandusky, Ohio. Two of Putnam's patents are No. 2,106,557 (issued January 25, 1938) and No. 2,360,791 (issued October 17, 1944).

Except for a few isolated exceptions such as Smith-Putnam, however, wind energy has not been exploited in the U.S. to generate electricity in commercial quantities. Yet, the technology has been of a continuing, albeit low level, source of interest and use for "on site", minimal requirement applications, such as housing remote from commercial electrical sources, and in airplanes. (An example of the latter is Patent No. 3,662,975, issued in 1972).

Recent Activity

As the high level of patent activity in recent years indicates, the interest in this technology is no longer low. Most of the current patent activity in wind generated electricity consists of improvements to the wind capturing portion of the machinery (i.e. the wind motor). Wind concentrators (e.g., Venturi's), types of wind blades and automatic adjustments for wind blades are some of the features involved. Low maintenance, reliable inexpensive contruction, and wind capturing efficiency are the major objectives.

Patents, issuing since December 1960, include the following:

2,964,111 (Morris) Discloses a wind turbine and governor to maintain constant speed and power output. The governor uses bellows units to control the pitch of the propeller blakes.

3,047,726 (Warnken, Studebaker-Packard Corporation) Discloses a propeller blade adapted to swing or pivot to minimize the sudden forces encountered when moving into a fast-moving air stream.

3,222,533 (MacKay) Discloses a windmill with blades that are sub-divided along their length, permitting the smaller diameter center blading section to revolve at a greater speed than the larger diameter blading. This allows each section of blading to produce its maximum amount of work, the speeds of each section of blading being reconciled through epicylical gearing to drive a common shaft.

3,339,078 (Cromxton) Discloses a Venturi shaped chamber with a wind turbine placed in the throat.

3,484,617 (Winsel) Discloses an electric power system using a fuel cell battery operated from storage tanks of hydrogen and oxygen. Wind drives a DC generator to supply energy to a pressure electrolysis battery. The electrolysis battery generates the hydrogen and oxygen for the storage tanks.

3,523,192 and 3,538,340 (Lang) Discloses the use of an underground reservoir to store air compressed by wind generated energy. The air is regulated at a relatively constant pressure by the natural hydrostatic pressure of the reservoir.

3,671,756 (Meier) Discloses an air driven wheel which is magnetically coupled to drive a plurality of electrical generators.

3,720,840 (Gregg) Discloses a turbine driven by wind captured at an inlet stack, and an exhaust stack with a heating element to enhance the flow of air.

3,730,643 (Davison) Discloses a plurality of sails mounted on a moving endless belt. The sails are adjustable about a verticle pivot to provide a maximum driving effort when moving with or across the wind and a minimum resistance when moving against the wind.

3,740,565 (Wesley, Beatrice N. Adams) Discloses an electric generator with multiple vaned rotors arranged in tandem. Magnetic segments are attached to the periphery of each rotor. Electricity is generated when the magnetic segments rotate past fixed stator armatures.

3,743,848 (Strickland) Discloses an electric generator using a wind turntable having radially spaced apart arms with a pivotable attached vanes.

3,793,530 (Carter) Discloses a turbine rotor mounted on a vertical axis with telescope sleeve. Lift wings are provided to lift a portion of the rotor assembly to reduce friction. The wind blades are adjustable, and driving propellers are provided to rotate the assembly during periods of low wind velocity.

3,883,750 (Uzzell, Natural Energy Systems, Inc.) Discloses a Venturi-shaped chamber with a fan type wind machine positioned in the throat. The chamber is oriented by a wind driven rudder.

3,895,236 (Herron, RCH Energy Corp.) Discloses an apparatus for using wind pressure to drive a shaft in reciprocating linear motion, which in turn drives a generator.

3,924,827 (Lois) Discloses a plurality of bouyant wings tethered to lines an appreciable distance above the earth's surface. The wings are manipulated in a manner such that the lines can be used to drive a generator.

3,942,025 (Ri) Discloses a wind mill for generating electricity on a fast moving conveyance (e.g. airplane, automobile, ship). The wind mill has blades consisting of hinged bowl-like wings which pivot into and out of circular openings on radially mounted arms.

3,942,026 (Carter) Discloses a wind turbine having a plurality of wind wheels mounted on each end of a single drive shaft. The drive shaft is supported on an elevated rotatable turntable which is oriented by a wind vane.

Technology Analysis by

Stuart Hecker
Patent Examiner

SECTION III

COMPARISON OF ECONOMIC AND PATENT DATA

Background

One of OTAF's goals is to "stimulate and enhance the use and useability of the patent file." As part of the effort to achieve that goal, OTAF publications are used to suggest ways in which patent information and data can beneficially be used by those who might not otherwise employ it.

The potential value in economic studies of patent statistics as an indicator or measure of technological output has long intrigued workers in the field. Attempts to use patent data in this way are not unknown. The economist, Jacob Schmookler, in his book Invention and Economic Growth (Harvard University Press, 1966), made extensive and enthusiastic use of patent data. However, such enthusiasm is by no means universal and the value of patent data in economic studies has been the subject of controversy[a].

A major impediment to the resolution of this controversy has been the sparse use of patent data due, in the past, to its relative inaccessability. As Schmookler notes on page 21 of his book, just one step in the development of the patent data he used "required a year of work in the search room of the Patent Office".

With the emergence of the Patent and Trademark Office's technology assessment and forecast program, U.S. patent activity data across all of technology became readily available. Yet, the data's usefulness in economic studies remained limited due to it's incompatibility with most available economic data. This incompatibility was a consequence of the fact that the patent data are based on the U.S. Patent Classification (USPC) system, while most economic data are collected on the basis of the Standard Industrial Classification (SIC) system.

However, in 1974, the Science Indicators Unit, National Science Foundation (NSF) commissioned OTAF to construct a partial concordance between the USPC and the SIC. This was done; and, relationships between the USPC and 36 categories of the SIC were established. Extensive raw data developed through use of that concordance were published in OTAF's Fifth Report, August 1975.

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[a] See "An Attempt to Measure the Rise of American Inventing and Decline of Patenting" by S.C. Gilfillan with a reply "An Economist Takes Issue" by Jacob Schmookler in Technology And Culture, Vol. 1, No. 3, Summer 1960.

In the interim, the concordance has been updated and refined, and the 36 original categories have been further broken down and now number 52. Additionally, consideration is now being given to the use of computer matching (as distinguished from subjective) techniques to create a broader scope, more detailed and scientifically reproducible concordance which would have enhanced usefulness.

Purpose

In this Section patent activity data, developed through use of the USPC-SIC concordance, are used for comparison, in six selected industries, with research and development (R & D) expenditures and the number of R & D scientists and engineers (R & D manpower) employed in those industries. The intent is not to present an exhaustive or definitive treatment of the subject, but rather to use the presentation as a medium to inform workers in economics and related fields of the availability of useable patent data and, perhaps, to stimulate thinking as to how this data might be employed.

Selection of Industries

As mentioned above, six SIC industries were selected for review in this Section. They are:

- Food and Kindred Products (SIC 20)
- Chemicals and Allied Products (SIC 28)
- Fabricated Metal Products (SIC 34)
- Machinery, Except Electrical (SIC 35)
- Electrical and Electronic Machinery, Equipment, and Supplies (SIC 36) Note: Also included in this group was Instruments for Measuring and Testing of Electricity and Electrical Signals - SIC 3825
- Measuring, Analyzing, and Controlling Instruments; Photographic, Medical and Optical Goods; Watches And Clocks (SIC 38 - except 3825)

For sake of convenience, the groups will be referred to, respectively, as: SIC 20, Food; SIC 28, Chemicals; SIC 34, Fabricated Metal Products; SIC 35, Machinery; SIC 36, Electrical & Communication Equipment; and, SIC 38, Scientific Instruments.

These groups were selected for a number of reasons. First, they represent a broad technological cross-section. Second, there is among them a wide variance in patenting levels. Third, they range in degree of R & D intensiveness from high (Chemicals, Machinery, Electrical & Communications Equipment, Scientific Instruments); to medium (Fabricated Metal Products); to low (Food) [b]. Fourth, the needed yearly economic data were available. Finally, inherent limitations of the patent data (to be discussed) were minimized in these groups.

The Economic Data

Two sets of economic data are used in this Section -- research and development (R & D) funds expenditures and R & D scientist and engineer man-years. The National Science Foundation is the source for all economic data used [c].

The R & D funds as reported by NSF have, in all cases, been converted to "constant 1967 dollars". Scientist and engineer data is reported by NSF as the number of full-time equivalent (part-time aggregated to full-time) persons employed in January of each year. This has been converted to estimated average man-years data by computing an average figure between two January values.

The Patent Data

Any discussion of the patent data used in this Section must be prefaced with an explanation of the process by which the USPC-SIC concordance was developed.

NSF furnished OTAF with a list of thirty-six product field categories and the SIC industries that had been grouped together to form each. Each of the thirty-six is defined mostly by one or more two or three-digit level SIC industries. In some cases four-digit specific industry codes are used.

At the time the project was undertaken, it was beyond the scope of the techniques available to establish, by mechanized means, a precise quantitative relationship between each of the about 90,000 USPC subclasses and the SIC categories. Therefore, OTAF undertook a manual and subjective process of relating the subclasses to the categories. The principal difficulty in this process stems from the difference in the philosophical basis for each system.

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[b] Source: Science Indicators 1974, page 93, National Science Foundation

[c] Research and Development in Industry 1973, NSF 75-315

The SIC is an establishment based classification system with its categories created to correspond to fields of industrial activity. The USPC, on the other hand, uses as its basis of classification the technological features that make inventions patentable - elements of structure; functions of products and apparatus; and, processes of manufacture.

Because of the nature of each classification system, the basic type of questions asked in relating patent classifications to SIC categories was: "What type of establishment would be engaged in producing the products or apparatus having the structural or functional features encompassed by that patent classification?" or "What type of establishment would be carrying out the process steps included in the patent classification?"

In those cases where the questions could not be clearly answered and ambiguity existed as to which of several possible SIC categories to assign a patent classification, it was placed in each. This was done on the theory that the technology disclosed in the patents in those classifications was pertinent to each of the several categories.

The documents that served as the basic tools in relating patent classification to the SIC were the U.S. Patent Classification Manual and the 1972 edition of the Standard Industrial Classification Manual. The fifteen volume set of Definitions of U.S. Patent Classifications was also used in those instances where Class and subclass titles were not sufficiently descriptive to permit assignment to product fields.

In the first phase of creating the concordance, each of the more than 300 Classes of the USPC was considered. For each Class it was determined whether the subject matter of the Class was sufficiently homogeneous to permit its assignment in whole or in major portion to the relevant SIC. More than one-half of the Classes were susceptible to assignment in this manner.

The detailed analysis of the non-homogeneous classes involved scanning subclass blocks within each Class to determine the extent to which they were amenable to assignment as a whole. If they were not, then each subclass was considered individually until all were assigned.

The NSF supplied list of SIC categories was limited almost exclusively to manufacturing industries and did not include fields such as construction, agriculture and most areas of mining. Even in manufacturing, industries such as tobacco, apparel, paper, furniture and lumber were not handled. Because the technological spectrum encompassed by the patent classification system is much broader than the industries specified by NSF, some areas of the USPC were excluded from the concordance.

With the completed concordance it is possible to access the OTAF data base and to "classify" all relevant U.S. patents into the SIC categories by placing all patents from a subclass into the corresponding category. This computerized "classification" involves a duplicate elimination procedure to eliminate the distorting effect of multiple counting of patents within a single category. Such duplicate counting would otherwise occur because of: 1) the Patent and Trademark Office practice of cross-referencing patents into all subclasses for which they contain novel disclosure; and, 2) the fact that in creating the concordance many related subclasses were often combined into a single SIC category.

Since the original concordance was developed, it has been twice updated to reflect the continuing changes in the patent classification system. In addition, as previously noted, some of the larger (in terms of numbers of patents) of the thirty-six SIC categories have been further broken down, resulting in the present total of fifty-two groups[d].

For purposes of this report, OTAF has selected four existing SIC categories and combined others so that all categories used are at the two digit SIC Major Group or industry level. Within these larger, comprehensive groupings, the patent data are more accurate, since the occurrence of technological "overlap" and, consequently, patent overlap (i.e. the same patent being assigned to more than one of the selected groups) is less likely.

The patent data used in this Section include only those patents which were assigned (owned) at time of issue by U.S. organizations. Patents are not included which, at time of issue, were: not assigned (i.e., owned by the inventor); assigned to foreign organizations; or, assigned to persons. This is done because the economic data used relates only to the R & D expenditures and manpower of U.S. industry and/or Government.

Throughout the Section the phrase "U.S. organizational patent" appears. This refers to U.S. patents which at time of issue were the property of U.S. organizations. These organizations are composed almost exclusively of corporations and U.S. Government agencies; although, included, as well, are patents which issued to institutions, mostly universities. However, previous OTAF studies indicate that the number of such institutional patents, as compared to those of corporations and Government, is so small as to have inconsequential effect in the statistical comparisons made in this Section.

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[d]This refinement was done at the request and with the support of NSF, which specified the groups to be further subdivided.

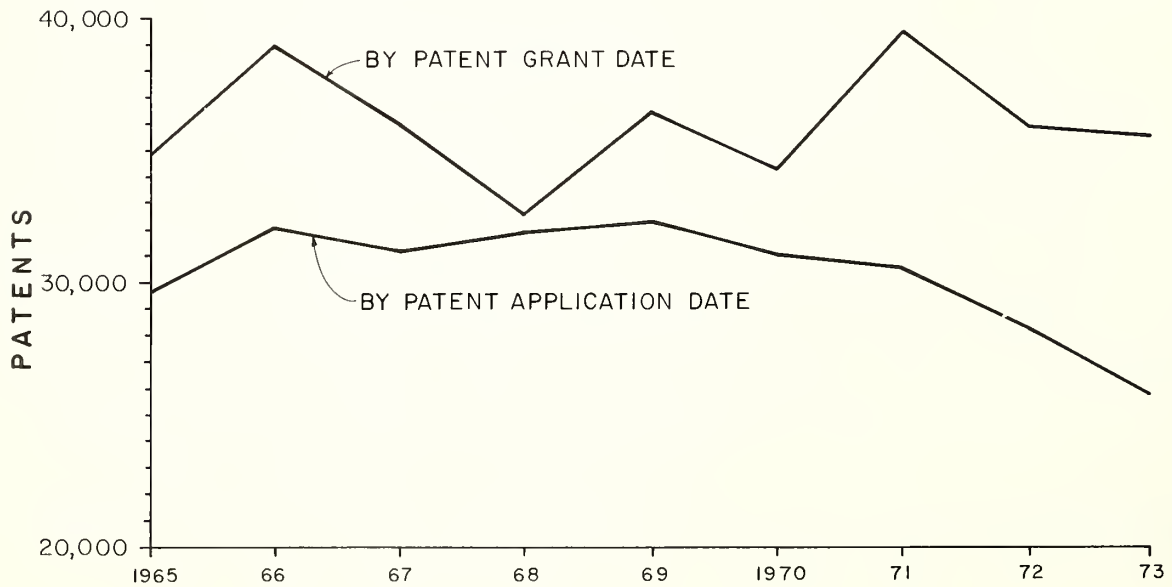
An important feature of the comparisons made in this Section is the use of patent data distributed on the basis of the dates on which the patent applications were filed, rather than the dates on which the patents were granted. This application date distribution more accurately approximates the period when the patented technology was developed. In addition, such distribution minimizes, if not eliminates, any skewing effects which Patent and Trademark Office internal patent application processing might introduce.

A clear indication of the differences involved when considering patent data by grant date and by application date is given by Figure 1. U.S. organizational patent activity for all six industries combined is given both by grant date and application date. The top line represents patents granted from 1965-1973. The lower represents patents granted from 1967-1975 distributed according to the date the applications for those patents were filed. Such distribution yields essentially complete patented application filing data from 1965-1973. (For a more detailed explanation of patent data distributed by application date, the reader is referred to and urged to read the "Explanation of Data" beginning on page 7.)

Two principal differences between the data sets are apparent from Figure 1. First, there is clearly a "smoothing" of the data by application date. Second, the effects of the Patent and Trademarks Office's successful backlog reduction program are shown in the consistently higher figures represented by the patent grant date curve.

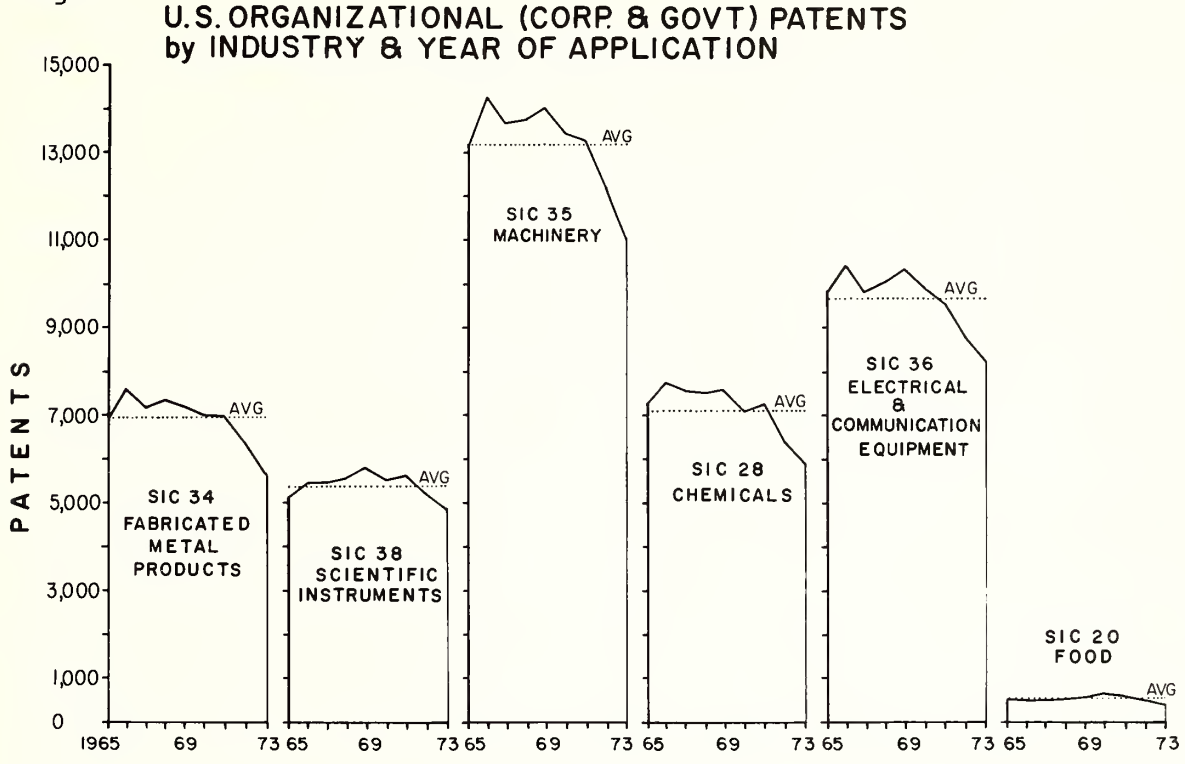
Figure 1

U.S. ORGANIZATIONAL (CORP. & GOVT) PATENT ACTIVITY in SIX SELECTED INDUSTRIES COMBINED



The combined patent data by application date of Figure 1 is broken into its component parts in Figure 2. Shown are the number of organizationally owned, granted patent applications which were filed in each of the six selected industries in each of the years 1965-1973.

Figure 2



In making the economic/patent data comparisons, the economic data have been lagged two years. The rationale for this is that R & D funds spent in a given year or R & D professional manpower used in a given year is not likely to result in a patent application within the same year, given development time, time needed for patent application preparation, etc.

The lag time chosen -- two years -- is an estimate of the time taken to develop a patentable invention and to file for that invention. A year was allowed for R & D efforts to develop the invention and to draw up the patent application. Also, since an applicant has up to a year to file for an application, a second year was added to the lag time. It is recognized that this lag time may vary. Other investigators might wish and are invited to try different lags.

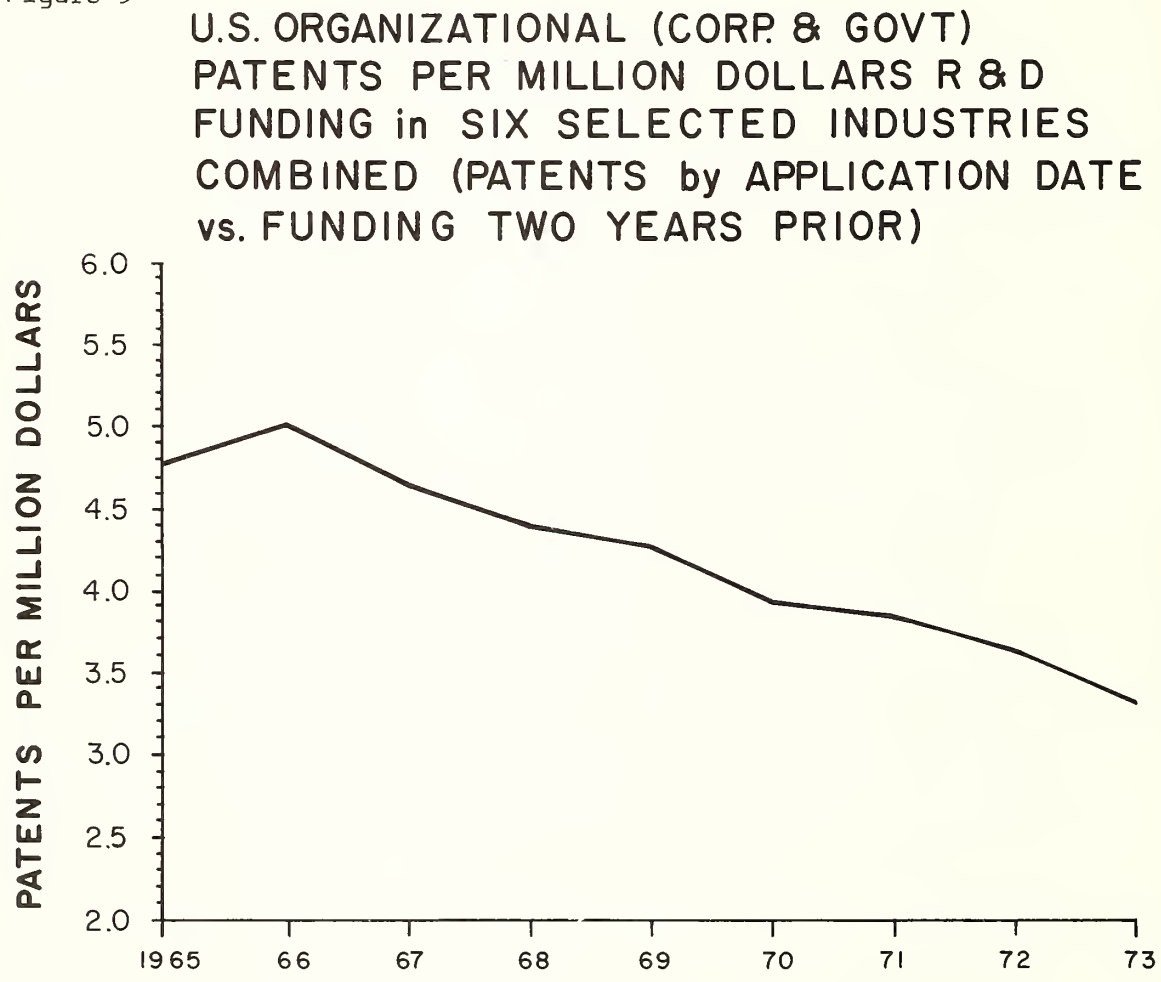
To facilitate such experimentation, the raw data used in this Section are presented in tabular form in Appendix C.

The Comparisons

The comparisons, overall and between industries, made in this Section are illustrated by a series of figures.

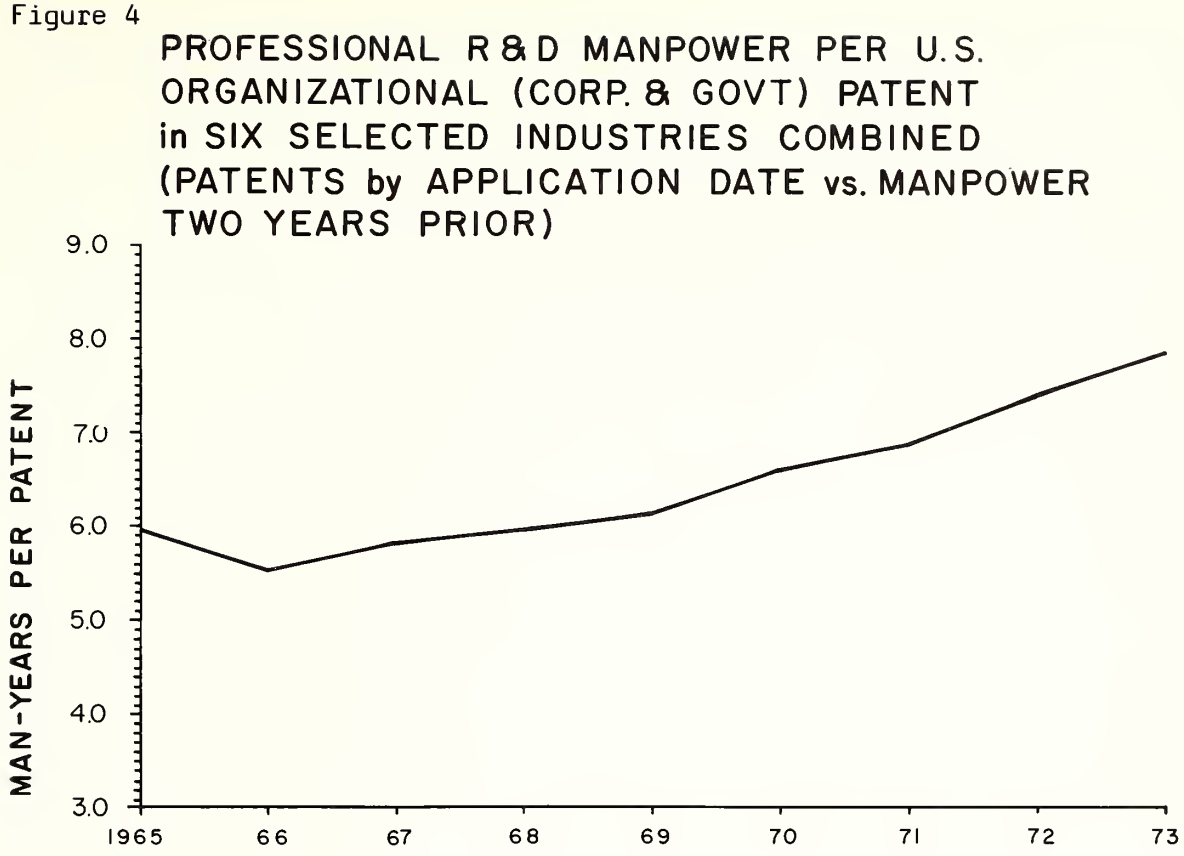
Figure 3 shows for each of the years 1965-1973, and for the six industries combined, the number of organizationally owned, granted patent applications that were filed for each million dollars of combined U.S. Government and industry R & D funds invested in the six industries two years previously.

Figure 3



Like Figure 3, Figure 4 (next page) also considers the six industries in combination. Shown are the number of U.S. industry and Government R & D scientist and engineer man-years for each U.S. organizationally owned, granted patent application filed two years later. The years shown --1965-1973 -- refer to the years in which the applications were filed.

Figure 4



Figures 5 below and Figure 6 (next page) are, respectively, similar to Figure 3 and 4. In the latter, however, the six industries are shown separately so that comparisons among them can be made.

Figure 5

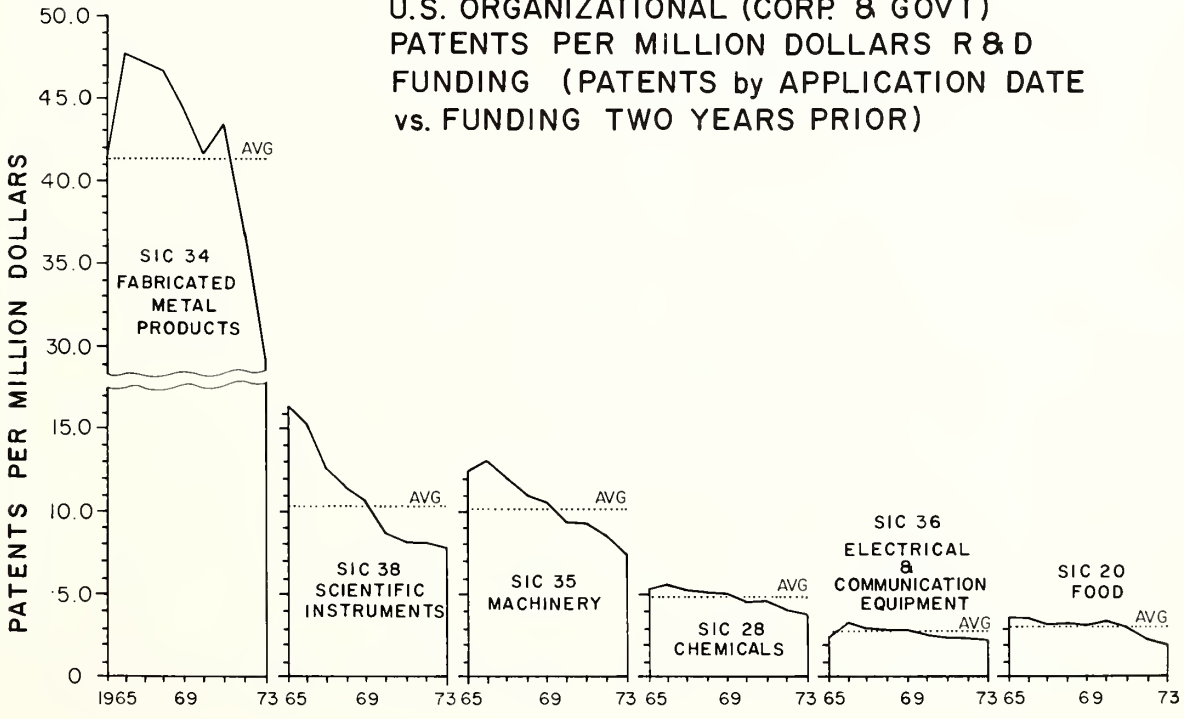


Figure 6

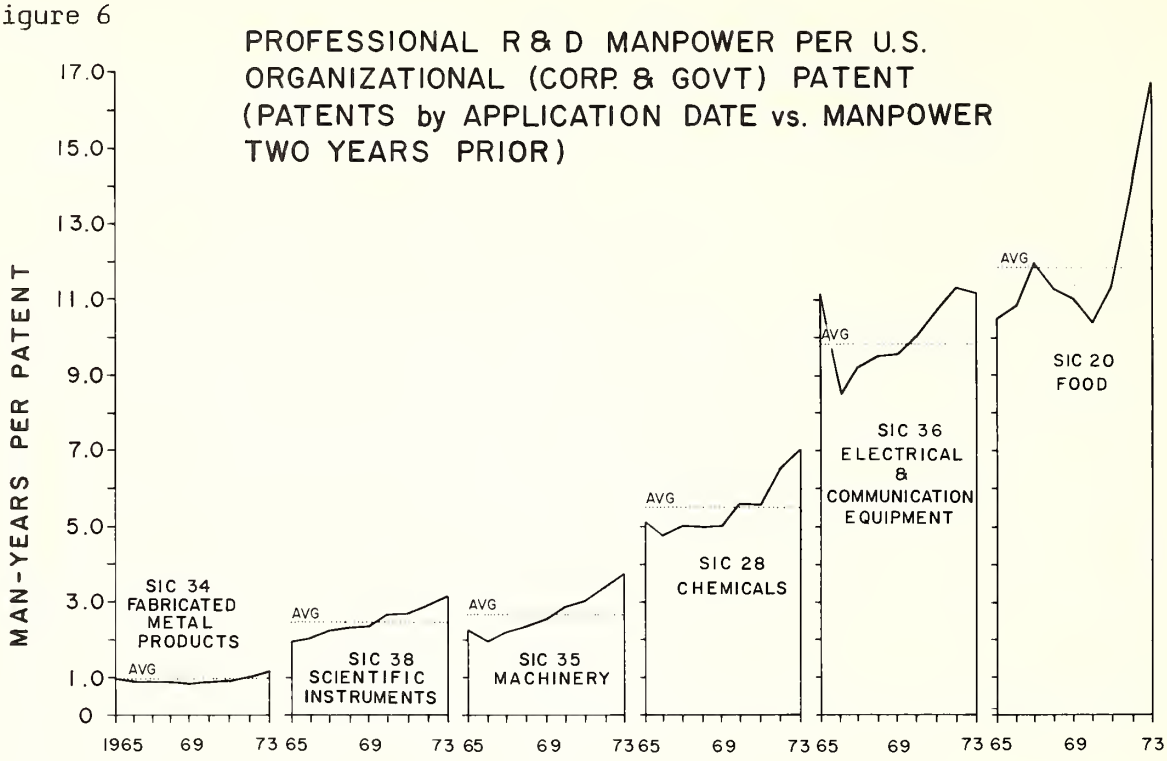
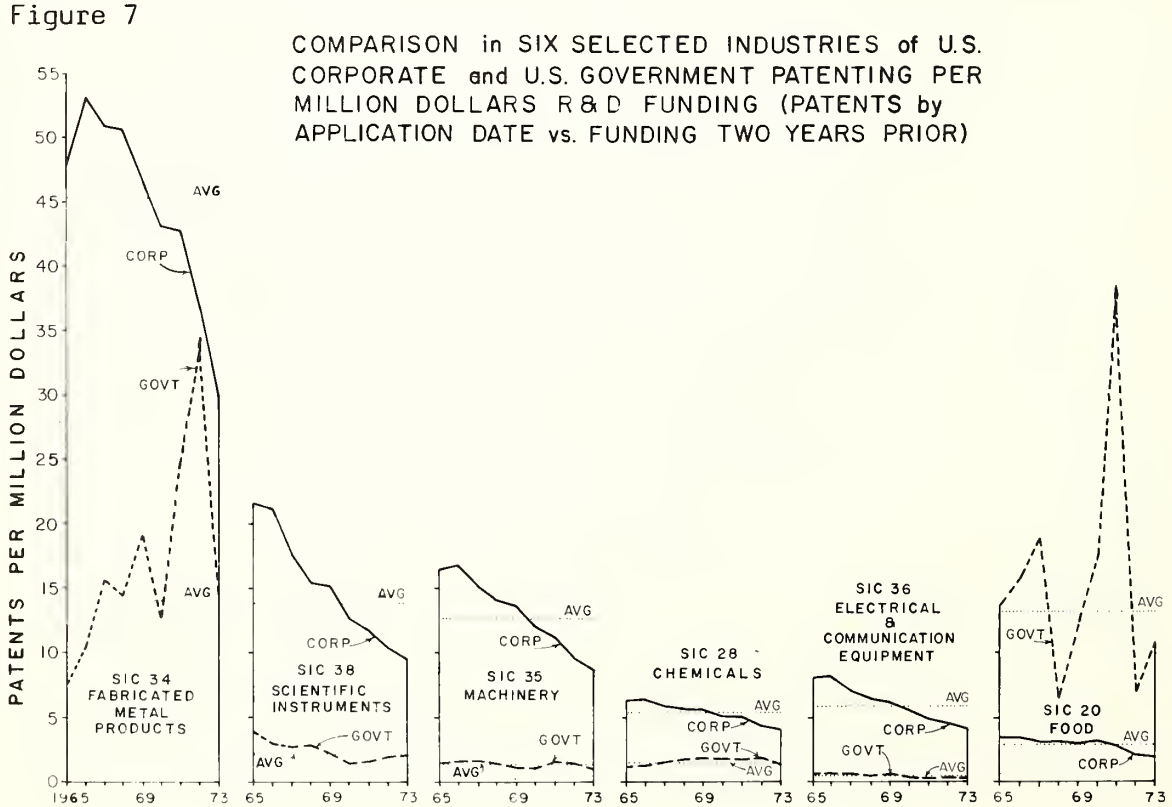


Figure 7, like Figure 5, is also directed to patents per million dollars R & D funding in each of the six industries. In Figure 7, however, the corporate and Government patents and funding are segregated and the ratios shown separately.

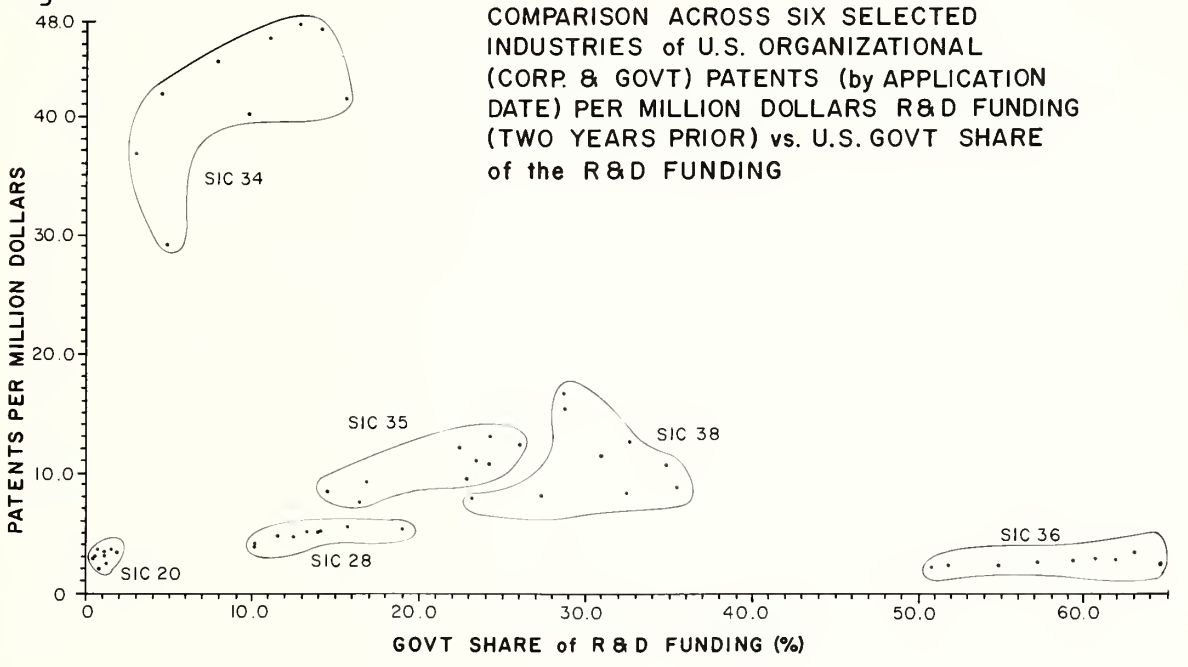
Figure 7



The final figure, Figure 8, differs substantially from the others. It represents an attempt to determine if a relationship exists between the size of the Government's share of R & D funding in an industry and the industry's patenting rate (in patents per million dollars total R & D funding two years previously).

For each of the six industries and each of the nine years, 1965-1973, that rate was plotted as a function of the Government's share of the R & D funding in the corresponding year. The result is the "scatter diagram" shown.

Figure 8



Comments

As stated at the beginning of this Section, the purpose of this exercise has been to inform and to stimulate:

- To inform those who may have use for it, that patent data are available;

- To stimulate thinking about how patent data might beneficially be employed to further and deepen our understanding of the interactions between technology and the economy.

Consequently, no extensive analysis of the comparisons presented here will be attempted. However, certain aspects of the data (some quite obvious) deserve comment because they are suggestive of the need for further study.

Even a casual review of the figures on the preceding pages reveals that over the time period, in each industry covered, there has been a decrease in the number of patents obtained per million dollars R & D invested and an increase in the professional man-years required for each patent obtained. Of course, in view of what must be a somewhat direct (as opposed to inverse) relationship between R & D dollars and R & D man-power, these results are probably but two aspects of one apparent phenomena. The phenomena, broadly stated, is that more resources (dollars and man-power) are going in and fewer patents are coming out.

There are several possible explanations for this, each of which would bear study. For example, three questions which come quickly to mind are:

- Has the great increase in technological complexity brought about a corresponding increase in the amount of effort (i.e. resources) required to "invent" something patentably different?

- Has the character of the patents changed over time? Are they now generally more comprehensive, including bigger "chunks" of increasingly complex technology?

- Is U.S. industry becoming less patent - minded? If so, why and what implications (technological and commercial), if any, does this have in view of the dramatic increase in foreign patenting in the U.S.?

Workers in related fields may find that the data suggest avenues of inquiry substantially different from these. We merely note the obvious to stimulate the inquiry of others.

With reference to Figure 8, the reader's attention is drawn to the apparent positive relationship, across industries, between the Government share of R & D funding and the patents per million dollars total R & D funding. In other words, this first rough "cut" at the data seems to indicate that in some industries there may be something of a "catalytic" or "seed money" effect of Government contributions to R & D.

Obviously, Figure 8 shows wide variance between industries. Yet, considering SIC's 20, 28, 35 and 38 as a group (and not SIC's 34 and 36), a regression analysis of the data yield a strong coefficient of correlation of 0.84 for a slope of 0.3. A regression of the data points of SIC 34, taken alone, reveals a slope of 0.8. Admittedly the data points here (9) are substantially fewer, but the correlation coefficient of 0.58 gives some evidence that the relationships may not be spurious. Obviously, the effects of significant variation in Government R & D funding on the patenting rate in SIC 36 were small. A regression of these data points confirms this with an almost negligible slope of 0.05.

SECTION IV

MOST CITED PATENTS

In this section patent documents are reviewed which were most often cited as pertinent in patents granted in 1975.

Background

Before a patent application is "allowed" and a patent granted, that application undergoes an examination, in accordance with current patent law, to determine the patentability of the claimed invention. A patent examiner trained in the technology and knowledgeable of the law performs this examination.

During the examination process, the examiner searches the pertinent portions of the "classified" (categorized) patent file. His purpose is to identify any prior disclosures of technology (most often found in U.S. or foreign patent documents) which might anticipate the claimed invention and preclude the issuance of a patent; which might be similar to the claimed invention and limit the scope of patent protection to which the applicant is entitled; or which, generally, reveal the state of the technology to which the invention is directed.

If such documents are found they are made known to the inventor and are "cited" in any patent which matures from the application. The applicant also may call attention to prior technological disclosures which he feels are pertinent and should be considered in the examination process. These documents, as well, are cited in the patent.

The citations contained in a patent, therefore, can be regarded as pertinent to the technology disclosed in that patent. Consequently, if a single document is cited in numerous patents, the technology revealed in that document is apparently involved in many developmental efforts. Thus, the number of times a patent document is cited may be a measure of its technological significance

Content

Complete citation data covering all U.S. utility patents first became available in machine readable form for patents issuing subsequent to December 1974. As a first step in the development of this data, OTAF has extracted patent citation information contained in the almost 72,000 U.S. patents which issued in 1975. From this information the five U.S. patents cited more than 20 times each and the most cited foreign patent were selected for review in this Section.

For each patent, the title, patent number, inventor, and assignee is presented along with a brief description of the invention. The latter is intended only to identify the technology to which the patent pertains. It is not intended to be an indication of the scope of the invention claimed in the patent or a Patent and Trademark Office evaluation or endorsement of the technology described.

ELECTRONIC IGNITION SPARK ADVANCE SYSTEM

U.S. Patent: 3,738,339

Inventors: Gerald O. Huntzinger
Leonard J. Sheldrake, and
Byron W. Johnson

Assignee: General Motors Corporation.

Technology:

Discloses an electronic ignition spark advance system for use with internal combustion engine transistor ignition systems having an ignition coil primary winding switching transistor.

A reference pulse is produced when a selected number of degrees before the top dead center position of each engine piston is reached. This enables an ignition spark advance gate to gate to a counter circuit a series of crankshaft position pulses, each indicating one degree of crankshaft rotation.

When the counter circuit has counted the number of crankshaft position pulses equal to the number of selected degrees before top dead center, an ignition signal is produced which extinguishes the ignition coil primary winding switching transistor and operates circuitry which produces a signal to enable the ignition spark advance gate.

To provide speed ignition spark advance, delay circuitry responsive to each ignition signal provides two consecutive delay periods during which the disabling of the ignition spark advance gate is delayed. Consequently, the counter circuit continues to count crankshaft position pulses during the delay periods, to provide a speed ignition spark advance equal in degrees to the number of crankshaft position pulses counted during the delay periods at any engine speed.

To provide two speed ignition spark advance limits, the first delay period is terminated with a first selected crankshaft position pulse count if it occurs before the end of this delay period. The second delay period is terminated with a second greater selected crankshaft position pulse count if it occurs before the end thereof.

To provide vacuum ignition spark advance, a vacuum spark advance signal is provided at the conclusion of the delay periods for the number of crankshaft position pulses equal to the degrees of vacuum ignition spark advance required. This enables the ignition spark advance gate to gate the crankshaft position pulses to the counter circuit after the delay periods.

METHOD FOR REFINING PIG-IRON INTO STEEL

U.S. Patent: 3,706,549

Inventors: Helmut Knuppel, Karl Brotzmann, Hans-Georg Fassbinder, Guy Savard, and Robert Lee

Assigned: Eisenwerk-Gesellschaft Maximilianshutte m.b.H, Sulzbach-Rosenberg Hutte

Technology:

Discloses a process of refining pig-iron into steel by blowing oxygen and a protective screen of an encasing gas through injecting means located at or near the bottom of a converter containing a melt of molten metal. The encasing gas, while protecting the injecting means, allows it to be consumed at substantially the same rate as the bottom of the converter so that the injecting means is not left projecting from the bottom of the converter. Desirably, the oxygen jet is circular in cross-section and the encasing gas is in the form of a concentric jet.

A converter for carrying out the method is made up of a pear-shaped sheet-steel casing having a refractory lining and an inserted bottom provided with nozzles in the form of metal tubes for the oxygen and encasing gas. Preferably, a substantial portion (for example about half) of the converter bottom is free of nozzles. The nozzles can be arranged in groups and there can be rows running parallel with the tilting axis of the converter. The nozzles may also be arranged to cause circulation of the molten metal in the converter. The nozzles can be constructed to provide for swirling movement of the encasing gas. Examples of encasing gas which may be used are furnace-mouth gas, coke-oven gas, natural gas and other gases containing hydrocarbons.

FIRE-RETARDANT SHEATH AND CORE TYPE CONJUGATE FIBERS

U.S. Patent: 3,658,634

Inventors: Masana Yanagi, Itaru Nakamura, Masayuki Ohosugi, Kiyosi Takisawa, Masanori Kakinam; and Chikara Sano.

Assignee: Toray Industries, Inc.

Technology:

The patent discloses a sheath and core type conjugated fiber comprising a thermoplastic sheath polymer, and a thermoplastic core polymer containing more than 5 percent by weight of a halogenated fire-retardant (e.g., pentabromo toluene) and a phosphorus compound fire-retardant (e.g., triphenylphosphate). The halogen content of the halogenated fire-retardant in the core polymer is present in an amount of about 3 to 50 times the amount of the phosphorus compound fire-retardant.

The fire-retardancy of the sheath and core type conjugate fiber of this invention is said to be remarkably high because a polymer having a high halogen concentration is used as the core component of the conjugated fiber.

MULTIPLEXING SYSTEM FOR SELECTION OF NOTES AND VOICES IN AN ELECTRONIC MUSICAL INSTRUMENT

U.S. Patent: 3,610,799

Inventor: George A. Watson

Assignee: North American Rockwell Corporation

Technology:

Discloses a digital selection system for calling forth desired tones and voices from those available to be produced in musical instruments. In the example of an electric organ, every key is scanned in cyclic sequence. The actuation of a key or keys is entered as information in a parallel digital format indicative of the order and combination of keys that have been actuated and deactuated. The parallel format is continuously converted to a serial format comprising pulses in appropriate time slots, preassigned to corresponding keys, of a time division multiplexed signal to provide information regarding key actuation. The multiplexed signal is supplied to the tone generating section of the organ for bringing forth the tones corresponding to those keys that have been actuated, in the order and combination of actuation.

The actuation of stop tab switches for selecting desired organ voices and footage or pitch lengths is also accomplished on the basis of a scanning of the stop switches and related components in a cyclic sequence. Information relating to the specific stop switches that have been actuated is furnished, in a parallel format based on organ voices, to a voicing computer. The computer accepts the incoming voice control data and accesses a related memory to compute the desired composite voicing information for entry into a serial digital format in a time division multiplexed waveform.

SKID CONTROL SYSTEM

U.S. Patent: 3,578,819

Inventor: Thomas M. Atkins

Assignee: Kelsey - Hayes Company

Technology:

Discloses a fluid-actuated wheeled vehicle brake skid control system containing a modulating valve for modulating the fluid pressure to the fluid-actuated brakes and a control circuit for controlling the valve in response to indications of wheel speed and/or wheel deceleration.

The modulating valve is actuated in response to an electrical signal indicating the occurrence of a preselected deceleration rate. In order to accommodate difnerent surface conditions and to enhance braking operation, operational characteristics are varied depending upon the surface condition which is sensed by sensing a spin-up time characteristic of the wheels being controlled during the time of brake relief. In addition, the time duration of valve operation is varied with road conditions and vehicle speed to relieve pressure at the brakes of the controlled wheels.

A vehicle speed analogue is provided which, during each brake relief, senses the linear velocity of the vehicle by sensing the velocity attained by the controlled wheels. This information is stored and is used for the next cycle to vary the time at which the brakes are reapplied in accordance with velocity. The sensed velocity signal is allowed to change with time during each cycle at a preselected rate such that at any time an analogue-approximating vehicle speed will be obtained.

Two separate means are provided for determining when the brakes are to be reapplied. One means senses wheel spin-up and is actuated at high spin rates indicating high surfaces; the analogue is used to effect this occurrence with velocity such that at higher velocities the wheels can spin up more. The second means senses vehicle deceleration and reapplies the brakes after a determinable interval. This latter means is designed to be sensitive to low surfaces; in addition, the time for reapplying the brakes is increased with velocity in accordance with the velocity analogue. The sensed velocity signal from the velocity analogue is also used to affect the brake release time.

NEW ARTICULAR PROSTHESIS FOR SURGICAL USE

French Patent: 1,047,640

Inventor: Henri Georges van Steenkruggle

Assignee: None Indicated

Technology:

Discloses a coxo-femural anticulation having the following characteristics:

- prefabricated true articulation to obtain precision and mechanical adjustment;
- the female part of the articulation is lodged in the cavity of the bone, hollowed or not, and is rendered solid on a very large support surface for maximum distribution of pressure;
- the male part of the articulation is constituted of a sphere adapted to the female prosthetic part, the diameter of this sphere is definitely smaller than that of the usual prosthesis so as to diminish the reaction of the friction couple on its pivot;
- a support device to maintain the roller in its cap to avoid post-operative dislocation;
- the outer shapes of the articulation parts are arranged so that their relative movements do not irritate, elongate or choke the neighboring tissues.

APPENDIX A

OBTAINING PREVIOUS OTAF PUBLICATIONS

Copies of the four previous OTAF publications listed below are available from:

National Technical Information Service
U.S. Department of Commerce
Springfield, Virginia 22161

When ordering from this source, please give the publication title and its "COM" number.

1. Initial Publication, May 1973
   COM 73-10767; Cost: Domestic - $5.50 Foreign - $8.00

   Describes OTAF program and gives sample reports on 24 wide ranging areas of technology in varying levels of detail.

2. Early Warning Report, December 1973
   COM 74-10150; Cost: Domestic - $9.25 Foreign - $11.75

   Spotlights those technological areas experiencing a high level of overall activity or of foreign activity. Reviews patent activity in a number of energy areas, including nuclear; solar; geothermal; and tide, wind and wave energy.

3. Third Report, June 1974
   COM 74-11383; Cost: Domestic - $7.50 Foreign - $10.00

   Presents an overview of the technological activity, across all technologies, of a group of selected foreign countries and a group of selected U.S. states. Extends energy area treatments to include oil shale and coal gasification technologies. Reviews additional high overall activity technological areas.

4. Fourth Report: A Review of Patent Ownership, January 1975
   COM 75-10050; Cost: Domestic - $6.00 Foreign - $8.50

   Identifies the 73 corporations and government agencies which received 500 or more patents during the five year period 1969-1973, and reviews and compares their patent activity across the spectrum of technology. Also reviews in terms of patent ownership, the patent activity during the same period, in nuclear energy technology and oil shale and coal gasification technology.

5. Fifth Report, August 1975
   COM 75-11142, Cost: Domestic - $6.75 Foreign $ 9.25

   Reviews 60 technological areas experiencing a high level of overall activity or of foreign activity, not previously reported on. Presents patent activity data in categories corresponding to 36 Product Fields of the Standard Industrial Classification System.

Microfilm of Previous Reports
Domestic - $2.25 per report; Foreign - $3.75 per report

APPENDIX B

OBTAINING ADDITIONAL INFORMATION OR SPECIAL REPORTS

Background

OTAF's computerized base of data relating to the patent file includes, at present:

- all subclasses of the U.S. Patent Classification System
- the relationship of all subclasses of the U.S. Patent Classification System to the Standard Industrial Classification System in 52 Product Fields and Product Field combinations
- for all U.S. patents, their recorded locations within the U.S. Patent Classification System
- for U.S. patents issued since 1963,
    - . the ownership at time of issue in seven categories (U.S. government, foreign government, U.S. corporation, foreign corporation, U.S. individual, foreign individual, and unassigned)
    - . the country or state of residence of the inventor
- for U.S. patents issued since 1967, the date the application for patent was filed in the U.S. Patent and Trademark Office.
- for U.S. patents issued since 1969, the specific (i.e. named) ownership of all which, at time of issue, were organizationally owned (e.g. by a corporation, foundation, government agency.

Data can be retrieved on the basis of any one or any combination of the factors listed above, manipulated on most any given basis and presented in a number of formats, e.g., lists, tables, graphs, charts, etc. This flexibility is illustrated by the various types of reports presented in this and the five preceeding OTAF publications.

How to Obtain Special Reports

1. In making an initial determination of interest in a special OTAF report, you are urged to review the data items that are available and decide if any one or combination of them, or any relationship between two or more of them might be useful to your needs.

2. In most instances, interest, once determined, will be limited to particular technological areas. The definition of these areas is of key importance and must ultimately be in terms of classes and subclasses of the U.S. Patent Classification System (or one of the 52 SIC Product Fields or Field combinations). If you are unfamiliar with the U.S. Patent Classification System, develop as clear and precise an explanation of your area(s) of interest as possible.

3. At this point, you should contact OTAF, indicate the type of information you desire and, if you wish, what your needs are. (Perhaps alternatives can be suggested to better meet those needs). If you cannot provide class and subclass definition of your area of interest, OTAF will attempt to do that for you, using your description of the area.

4. Once there is a clear mutual understanding of the information you want, the format in which you want it and the area(s) to be included, an estimate of cost will be developed and provided to you along with a statement of the work to be done.

5. Once agreement on work to be done and cost is reached, and payment is received, the report will be prepared and provided.

Costs

All special reports are prepared on a cost reimbursable basis. These costs may vary widely - from as low as $100 to $300 for a statistical report (including a list of covered patents) of the type contained in Section I of this publication, to several thousand dollars for complex and large scale treatments of many technological categories, requiring extensive programming or computer time; or for in-depth reports which focus on the substantive content of the covered patents and require substantial professional analysis time.

Whom to Contact

Inquiries concerning OTAF publications/services are invited and should be directed to:

Office of Technology Assessment
and Forecast
U.S. Patent and Trademark Office
Washington, D.C. 20231
Phone: (703) 557-3050

APPENDIX C

SECTION III DATA TABLES

This Appendix contains, in tabular form, the data used in the comparisons of economic and patent data in Section III. For each Figure of Section III there is presented a correspondingly numbered table which reflects the data relied upon in the Figure.

TABLE 1. U.S. ORGANIZATION (CORP. & GOVT.) PATENT ACTIVITY IN SIX SELECTED INDUSTRIES COMBINED

	Number of Patents	
YEAR	By Patent Grant Date	By Patent Application Date
1965.....	34,791	29,579
1966.....	38,854	32,006
1967.....	36,022	31,154
1968.....	32,556	31,902
1969.....	36,451	32,282
1970.....	34,318	31,051
1971.....	39,553	30,553
1972.....	35,972	28,270
1973.....	35,598	25,750

TABLE 2. U.S. ORGANIZATIONAL (CORP. & GOVT.) PATENTS BY INDUSTRY & YEAR OF APPLICATION

Date	SIC 34 Fabricated Metal Products	SIC 38 Scientific Instruments	SIC 35 Machinery	SIC 28 Chemicals	SIC 36 Electrical & Communication Equipment	SIC 20 Food
1965	6962	5118	13155	7253	7808	516
1966	7624	5452	14288	7715	10458	551
1967	7216	5449	13695	7562	9773	518
1968	7397	5551	13864	7493	10057	541
1969	7294	5782	14018	7552	10359	560
1970	7068	5525	13451	7098	9965	606
1971	6985	5610	13257	7227	9517	558
1972	6390	5220	12207	6400	8785	460
1973	5659	4824	11012	5922	8226	396
AVE	6955	5392	13217	7136	9663	524

TABLE 3. U.S. ORGANIZATIONAL (CORP. & GOVT.) PATENTS PER MILLION DOLLARS R&D FUNDING IN SIX SELECTED INDUSTRIES COMBINED (PATENTS BY APPLICATION DATE vs FUNDING TWO YEARS PRIOR)

Year	Patents By Application Date	R&D [a] Expenditures (Millions)	Patents Per Million Dollars R&D
1965.....	29,579	6176	4.8
1966.....	32,006	6368	5.0
1967.....	31,154	6708	4.6
1968.....	31,902	7262	4.4
1969.....	32,282	7589	4.3
1970.....	31,051	7885	3.9
1971.....	30,553	7996	3.8
1972.....	28,270	7779	3.6
1973.....	25,750	7778	3.3

[a] GNP implicit price deflators used to convert current dollars to constant 1967 dollars.

TABLE 4. PROFESSIONAL R&D MANPOWER PER U.S. ORGANIZATIONAL (CORP. & GOVT.) PATENT IN SIX SELECTED INDUSTRIES COMBINED (PATENTS BY APPLICATION DATE vs MANPOWER TWO YEARS PRIOR)

Year	Manpower (Thousands)	Patents by Application Date	Manpower Per Patent
1965.....	176.3	29,579	6.0
1966.....	177.2	32,006	5.5
1967.....	182.3	31,154	5.9
1968.....	190.0	31,902	6.0
1969.....	197.5	32,282	6.1
1970.....	205.0	31,051	6.6
1971.....	210.2	30,553	6.9
1972.....	208.3	28,270	7.4
1973.....	202.6	25,750	7.9

TABLE 5. U.S. ORGANIZATIONS (CORP. & GOVT.) PATENTS PER MILLION DOLLARS
R&D FUNDING (PATENTS BY APPLICATION DATE vs FUNDING TWO YEARS PRIOR)

	1965	1966	1967	1968	1969	1970	1971	1972	1973
SIC 34-Fabricated Metal Products									
Patents	6962	7624	7216	7397	7294	7068	6985	6390	5659
R&D Expenditures (Millions)[a]	168	160	153	159	164	176	167	174	194
Patents Per Million Dollars	41.4	47.7	47.2	46.5	44.5	40.2	41.8	36.7	29.2
SIC 38-Scientific Instruments									
Patents	5118	5452	5449	5551	5782	5525	5610	5230	4824
R&D Expenditures (Millions)[a]	312	358	427	483	542	635	673	648	619
Patents Per Million Dollars	16.4	15.2	12.7	11.5	10.7	8.7	8.3	8.1	7.8
SIC 35-Machinery									
Patents	13155	14288	13695	13864	14018	13451	13259	12207	11012
R&D Expenditures (Millions)[a]	1052	1096	1130	1256	1326	1420	1409	1434	1475
Patents Per Million Dollars	12.5	13.0	12.1	11.0	10.6	9.5	9.4	8.5	7.5
SIC 28-Chemicals									
Patents	7253	7715	7562	7493	7552	7098	7227	6400	5922
R&D Expenditures (Millions)[a]	1358	1387	1438	1452	1507	1527	1522	1535	1513
Patents Per Million Dollars	5.3	5.6	5.3	5.2	5.0	4.7	4.7	4.2	3.9
SIC 36-Electrical & Communications Equipment									
Patents	7808	10458	9793	10037	10359	9965	9517	8785	8226
R&D Expenditures (Millions)[a]	3145	3211	3394	3743	3867	3947	4037	3933	3772
Patents Per Million Dollars	2.5	3.3	2.9	2.7	2.7	2.5	2.4	2.2	2.2
SIC 20-Food									
Patents	516	551	518	541	560	606	558	460	396
R&D Expenditures (Millions)[a]	143	156	166	169	183	180	188	204	204
Patents Per Million Dollars	3.6	3.5	3.1	3.2	3.1	3.4	3.0	2.3	1.9

[a] GNP implicit price deflators used to convert current dollars to constant 1967 dollars.

TABLE 6. PROFESSIONAL R&D MANPOWER PER U.S. ORGANIZATIONAL (CORP. & GOVT.) PATENT (PATENTS BY APPLICATION DATE vs MANPOWER TWO YEARS PRIOR

	1965	1966	1967	1968	1969	1970	1971	1972	1973
SIC 34-Fabricated Metal Products									
Products									
Manpower(thousands)	6.9	6.8	6.5	6.3	5.9	6.1	6.3	6.4	6.7
Patents	6962	7624	7216	7397	7294	7068	6985	6390	5659
Manpower/patent	1.0	0.9	0.9	0.9	0.8	0.9	0.9	1.0	1.2
SIC 38-Scientific Instruments									
Manpower(thousands)	10.1	11.2	12.0	12.8	13.6	14.6	15.0	15.0	15.1
Patents	5118	5452	5449	5551	5782	5525	5610	5230	4824
Manpower/patent	2.0	2.1	2.2	2.3	2.4	2.6	2.7	2.9	3.1
SIC 35-Machinery									
Manpower (thousands)	29.3	28.3	29.9	32.1	35.5	38.4	40.4	40.9	40.8
Patents	13155	14288	13695	13864	14018	13451	13259	12207	11012
Manpower/patents	2.2	2.0	2.2	2.3	2.5	2.9	3.1	3.3	3.7
SIC 28-Chemicals									
Manpower(thousands)	37.1	36.9	37.9	37.5	37.9	39.6	40.3	41.5	41.9
Patents	7253	7715	7562	7493	7552	7098	6985	6390	5659
Manpower/patents	5.1	4.8	5.0	5.0	5.0	5.6	5.8	6.5	7.4
SIC 36 - Electrical & Communication Equipment									
Manpower (thousands)	87.7	88.7	89.9	95.3	98.5	100.0	102.0	98.8	91.5
Patents	7808	10458	9793	10037	10359	9965	9517	8785	8226
Manpower/patent	11.2	8.5	9.2	9.5	9.5	10.0	10.7	11.3	11.1
SIC 20-Food									
Manpower (thousands)	5.4	5.9	6.2	6.1	6.2	6.3	6.3	6.5	6.7
Patents	516	551	518	541	560	606	558	460	396
Manpower/patent	10.5	10.8	12.0	11.2	11.1	10.5	11.3	14.1	16.8

TABLE 7. COMPARISON IN SIX SELECTED INDUSTRIES OF U.S. CORPORATE AND U.S. GOVERNMENT PATENTING PER MILLION DOLLARS R&D FUNDING (PATENTS BY APPLICATION DATE vs FUNDING TWO YEARS PRIOR)

	1965		1966		1967		1968		1969		1970		1971		1972		1973	
	Corp.	Govt.	Corp.	Govt.	Corp.	Govt.	Corp.	Govt.	Corp.	Govt.	Corp.	Govt.	Corp.	Govt.	Corp.	Govt.	Corp.	Govt.
SIC 34-Fabricated Metal Products																		
Patents	6765	197	7412	212	6968	248	7143	254	7045	249	6848	220	6804	181	6215	175	5528	131
R&D Expenditures (Millions)[a]	141	26	139	20	137	16	141	17	151	13	159	17	160	7	169	5	185	9
Patents Per Million Dollars	48.0	7.6	53.3	10.6	50.9	15.6	50.5	14.9	46.7	19.1	43.2	12.9	42.5	24.7	36.8	35.0	29.9	14.5
SIC 38-Scientific Instruments																		
Patents	4771	347	5143	309	5084	365	5147	904	5380	402	5203	322	5260	350	4891	329	4515	309
R&D Expenditures (Millions)[a]	222	89	255	103	287	140	333	150	353	189	410	225	455	218	470	177	476	143
Patents Per Million Dollars	21.5	3.90	20.2	3.0	17.7	2.6	15.4	2.7	15.2	2.1	12.7	1.4	11.6	1.6	10.4	1.8	9.5	2.2
SIC 35-Machinery																		
Patents	12789	366	13921	367	13302	393	13475	389	13629	389	13074	377	12921	338	11928	279	10743	269
R&D Expenditures (Millions)[a]	778	274	831	266	876	253	961	295	1004	322	1096	324	1171	238	1226	208	1233	242
Patents Per Million Dollars	16.4	1.3	16.8	1.4	15.2	1.6	14.0	1.3	13.6	1.2	11.9	1.2	11.0	1.4	9.7	1.3	8.7	1.1
SIC 28-Chemicals																		
Patents	6970	283	7442	273	7262	300	7181	312	7208	344	6784	314	6944	283	6129	271	5708	214
R&D Expenditures (Millions)[a]	1102	257	1169	218	1236	203	1258	194	1297	210	1335	191	1346	176	1379	156	1360	153
Patents Per Million Dollars	6.3	1.1	6.4	1.3	5.9	1.5	5.7	1.6	5.6	1.6	5.1	1.6	5.1	1.6	4.4	1.7	4.2	1.4
SIC 36-Electrical & Communications Equipment																		
Patents	9145	663	9800	658	9129	664	9407	650	9651	708	9376	589	9003	514	8252	533	7740	486
R&D Expenditures (Millions)[a]	1116	2029	1187	2023	1291	2103	1472	2271	1571	2296	1692	2254	1824	2212	1818	1966	1857	1915
Patents Per Million Dollars	8.2	0.3	8.3	0.3	7.1	0.3	6.4	0.3	6.1	0.3	5.5	0.3	4.9	0.2	4.5	0.3	4.2	0.25
SIC 20-Food																		
Patents	486	30	534	17	498	20	527	20	535	25	572	34	522	36	442	18	378	18
R&D Expenditures (Millions)[a]	140	2.2	154	1.1	165	1.1	166	3.1	181	2.0	178	1.9	187	0.9	202	2.6	203	1.7
Patents Per Million Dollars	3.5	13.7	3.5	15.7	3.0	18.9	3.2	6.5	3.0	12.5	3.2	17.7	2.8	40.0	2.2	6.9	1.9	10.6

[a] GNP inplicit price deflators used to convert current dollars to constant 1967 dollars.

TABLE 8. COMPARISON ACROSS SIX SELECTED INDUSTRIES OF U.S. ORGANIZATIONAL (CORP. & GOVT.) PATENTS (BY APPLICATION DATE) PER MILLION DOLLARS R&D FUNDING (TWO YEARS PRIOR) vs U.S. GOVT. SHARE OF THE R&D FUNDING

	1965	1966	1967	1968	1969	1970	1971	1972	1973
SIC 34-Fabricated Metal Products									
Patents Per Million Dollars	41.4	47.7	47.2	46.5	44.5	40.2	41.8	36.7	29.2
% Govt. Research	15.7	12.8	10.4	11.0	7.9	9.8	4.4	3.0	4.7
SIC 38-Scientific Instruments									
Patents Per Million Dollars	16.4	15.2	12.7	11.5	10.7	8.7	8.3	8.1	7.8
% Govt. Research	28.6	28.7	32.7	31.0	34.9	35.5	32.4	27.4	23.1
SIC 35-Machinery									
Patents Per Million Dollars	12.5	13.0	12.1	11.0	10.6	9.5	9.4	8.5	7.5
% Govt. Research	26.1	24.2	22.4	23.5	24.3	22.8	16.9	14.5	16.4
SIC 28-Chemicals									
Patents Per Million Dollars	5.3	5.6	5.3	5.2	5.0	4.7	4.7	4.2	3.9
% Govt. Research	18.9	15.7	14.1	13.4	13.9	12.5	11.6	10.2	10.1
SIC 36-Electrical & Communications Equipment									
Patents Per Million Dollars	2.5	3.3	2.9	2.7	2.7	2.5	2.4	2.2	2.2
% Govt. Research	64.5	63.0	62.0	60.7	59.4	57.1	54.8	51.9	50.8
SIC 20-Food									
Patents Per Million Dollars	3.6	3.5	3.1	3.2	3.1	3.4	3.0	2.3	1.9
% Govt. Research	1.5	0.7	0.6	1.8	1.1	1.1	0.5	1.3	0.8

APPENDIX D

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